Experiments and Observations bearing on the Explanation of Form and Colouring, 1908–1913.

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1. GENERAL INTRODUCTION.

A. Work to be described.

When I was in England in 1908 my old friend Mr. G. A. K. Marshall, who, since he first guided my ardour for Natural History into useful channels in the Natal Coast Bush and at Salisbury in 1897, has never ceased to help and encourage me in every possible way, strongly urged me to carry out on my return to Chirinda a series of experiments designed to test the validity of the current theories of mimicry. He suggested the following programme:—

> "1. The testing of every available butterfly (and where possible its larva and pupa) on every available bird, and a rough classification of the insects into grades of palatability for every animal used.
>
> "2. The testing by a special series of experiments of Müller's assumption that the experimental destruction would be the same for every type of warning coloration.
>
> "3. A careful account of the habits and flight of all distasteful species and their mimics.
>
> "4. The releasing of damaged butterflies to wild birds.
>
> "5. Tests whether birds are deceived by resemblances in their prey."

Professor Poulton, in a letter dated May 26th, 1909, wrote:—"I am most anxious to know about the edibility of the forms that, in my opinion, probably belong to a second category of distastefulness—long behind the Danaines and Acræas, but still, I believe, distasteful . . . any forms that have fairly conspicuous undersides."

A little later he and Mr. Marshall independently suggested to me that I should make a special point of investigating the defences of the larger species of *Charaxes*.

I would like to say at once that not only am I indebted to these two friends for the inspiration to much work that I have found most fascinating and absorbing, but that both have continued to be lavish of help and encouragement and most generous in their gifts to me of their own and other publications on the subject. I can say without exaggeration that any value that work may possess is primarily due to them. And they have gone to immense trouble over the identification of my insects. Also, I have to leave for Africa before this paper goes to press and Professor Poulton, with the utmost kindness, has offered to see it through for me—a very laborious task, I fear. Dr. Rendle, Mr. S. Moore, Mr. E. G. Baker, Mr. G. A. Boulenger, Mr. Oldfield Thomas, and Mr. Dollman have all kindly helped me with identifications and often suggestions, and Mr. H. Eltringham with much useful suggestion and advice. Mr. David Odendaal and his young brother Thompson Odendaal helped very much in Africa in the collection of material, particularly for my experiments on carnivorous animals. I am indebted to Mr. H. C. Bryant, Dr. F. A. Dixey, Prof. Newstead, Mr. S. A. Neave, and Mr. J. C. F. Fryer for copies of their papers, a form of help that I have found very useful. My kind friend, the late Miss H. J. Robins, in the midst of exacting work of her own, insisted on devoting her already too scanty spare time to "helping on the cause of science," as she put it, in typing for me a considerable portion of the present paper. And last, but not least, I wish to acknowledge my debt to my wife. Her help, which, apart from encouragement, has taken the form of the papering of some thousands of insects and the laborious copying out of much of my very illegible manuscript, has been invaluable.

Interesting suggestions arising out of my results tempted me in July, 1911, to add very greatly to the original programme. A first attempt to work out and piece together my general experimental results to that date had not only shown me that that original programme was now nearly sufficiently completed, but, in conjunction with certain of my observational results, had strongly suggested considerations which, it seemed to me, would, if generally applicable, aid in accounting for some rather difficult facts in animal coloration—including many to which "sexual selection" had been somewhat unsuccessfully applied.

So other animals were now to be used besides birds, other prey besides insects, the main subject of enquiry was no longer to be mimicry, and such further points as the validity of sexual selection were to be tested with some degree of thoroughness. The net result, had I carried out my new programme as fully as I intended, would have been the postponement of publication for very many years more. However, both Professor Poulton and Mr. Marshall, to whom I sent a first account of my results, new ideas, and further plans in February of 1912, strongly, and I think rightly, urged me at least to commence publishing my detailed experiments soon, while reserving any full discussion of my main conclusions until I should have satisfied myself, by means of this further work, of their probability. Hence—after a delay caused by the execution of my extended programme on a smaller scale than I had intended—this paper.

My intended order of publication is as follows :—

1. Experiments on wild birds, devised mainly to ascertain :
    (*a*) Whether or no they readily prey on butterflies ;
    (*b*) Some of their preferences,

Here I include also experiments on unconfined Ground-Hornbills and, for comparison of its tastes with those of wild individuals of the same species, my experiments on a captive Bee-eater.

2. As a standard for comparison, my perhaps most complete series of preference experiments—that on my captive Rollers.

3. Experiments on insect-eaters other than birds, experiments on carnivorous and other animals, including my experiments in connection with plants.

In this introduction I will deal with the objections which, to my knowledge, have been brought against the experimental method. There will remain the objections to a selectionist view—as "Hypertely," "valuelessness of incipient resemblance," "instinctive knowledge of food-values," "night-hunting of the larger Carnivora," and so on. I have special work bearing on all of them and I hope to describe it in detail in some future publication, but I will meanwhile state its bearing, quite briefly, in giving my conclusions at the end of the third section. This third section does, I think, suggest that the conclusions we may draw from our results on insects are probably capable of a very extended application. It will be followed by a brief preliminary statement of the bearing of the general results on the theories of animal coloration.

There will still remain for later and separate publication :

4. The remaining experiments on captive insectivorous animals and on eaters of birds' eggs and insects' eggs.

5. Such observations, fairly extensive, as have been made on the habits and usual backgrounds of the various species of prey used in the experiments ; and some account of the habits, relatively to them, of their enemies. Final conclusions from the whole of the work.

Captive insectivorous animals experimented on.

My best series of preference experiments in insects have been on four species of birds—on *Lanius collaris*, Linn., and *Dicrurus afer*, Licht., amongst Passerines, and on *Halcyon cyanoleucus*, Vieill., and *Coracias garrulus*, Linn., in the Picariæ.

Other useful series of experiments, "preference" or otherwise, have been on a monkey (*Cercopithecus albogularis beirensis*, Poc.) ; on four Passerine birds (*Emberiza major orientalis*, Shelley, *Phyllastrephus milanjensis*, Shelley, *Pycnonotus layardi*, Gurney, and *Crateropus kirki*, Sharpe), two Picarians (*Lophoceros melanoleucus*, Licht., and *Merops apiaster*, Linn.), an Owl (*Syrnium woodfordi*, Smith), two Falconidæ (*Aquila wahlbergi*, Sundev., and *Asturinula monogrammica*, Temm.), and a Francolin (*Francolinus shelleyi*, Grant); on a lizard (*Mabuia striata*) and a chameleon; and on a few Arthropods, notably a Solpugid (*Solpuga sagittaria*, Poc.), a Locustid (*Enyaliopsis petersi*, Schaum), a Tenebrionid beetle, a dragon-fly (*Anax speratus*, Hagen), and Asilidæ (mainly *Alcimus rubiginosus*, Gerst.).

A very large number of experiments were carried out on European and Lesser Stripe-breasted Swallows (*Hirundo rustica*, Linn., and *H. puella*, Temm.), but the *preference* results were hardly in proportion to the time and labour expended, as it was before I had learned to experiment effectively. Other insect experiments that were to some extent wasted for the same cause, or else were very scanty, were on *Cercopithecus pygerythrus*, F. Cuv., *Papio cynocephalus*, Geoff., *Crossarchus fasciatus*, Desm., *Petrodromus tetradactylus*, Pet., *Dendromys* spp., *Hyphantornis jamesoni*, Sharpe, *Coliopasser ardens*, Bodd., *Lanius collurio*, Linn., *Telephonus senegalus*, Linn., *Phyllastrephus flavistriatus*, Sharpe, *Apalis thoracicus*, Shaw & Nodder, *Irrisor erythrorhynchus*, Lath., *Centropus burchelli*, Swains., *Lophoceros leucomelas*, Licht., *Chrysococcyx cupreus*, Bodd., *Bubo maculosus*, Vieill., *Francolinus coqui*, Smith, *Pternistes humboldti*, Peters, *Numida mitrata*, Pall., *Lobivanellus lateralis*, Smith, a toad, a lizard (*Agama* sp.), Mantidæ, *Harpactor erythrocnema*, and one or two other Reduviidæ.

Unconfined predaceous arthropods tested to some slight extent have been spiders and driver-ants (*Dorylus* sp.). A list of the unconfined birds will be given later. The main experiments here have been on Bee-eaters (*Merops apiaster*, Linn.), a Bush-Shrike (*Dryoscopus guttatus*, Hartl.), a Robin (*Tarsiger stellatus*, Vieill.), a Drongo (*Dicrurus ludwigi*, Smith)—all of these actually wild; also tame but unconfined Ground-Hornbills (*Bucorax cafer*, Boc.). But attacks, in some cases numerous, were watched in the case of thirty-five species of unconfined birds in all. I have some other evidence bearing on the question "Do Birds eat Butterflies?" besides that contained in Section 1 of this paper, and I will postpone any really full discussson of the point until I shall have published it.

Some attempt has been made to carry out the experiments generally on a sufficiently large scale. They number at the moment of writing about 1600 in all, including the 120 experiments and special observations on wild birds that are for the most part comprised in Section 1. I believe that approximately 20,000 insects (not including the very numerous small grasshoppers that were so often given simply to alter the state of an animal's appetite) have been used in all in the course of the experiments, and of these all but two or three thousand were butterflies. And some were offered many times over. Here I would like to say, in view of some recent criticism (Proc. Ac. Nat. Sci. Philad. 1912, pp. 281-364), that Professor Poulton was from the start foremost in urging on me the necessity for testing the question of preferences on no small scale but with *masses* of material, not with one or two offerings of each species but with *many*.

I comment later on the carnivorous and other animals used. Some of the results were very interesting. I was much disappointed at not securing a lion or a leopard for my trials of the larger mammals, particularly of man, my experiments with the flesh of whom were prompted by Darwin's admitted difficulty in accounting for the smells of the different races and certain other distinctive characteristics in man generally. I trapped for months, as did very kindly my nearest neighbour, Mr. W. N. Odendaal. On one occasion a leopard was actually caught, but had, when discovered, already found a weak spot in the trap and was in the act of breaking out, so had to be shot. I intend to try again. The Herbivora used were domestic, and I had not time before leaving Africa to complete the experiments. They are sufficient for my present preliminary purpose.

It will be noticed, finally, that though the experiments included in this paper and those yet to be published are mostly and primarily preference experiments, many defences other than "nauseousness" have been tested, and, in special connection with Mimicry, there have been numerous trials as to whether animals are deceived by resemblances in their prey. Of the insects thus used the following species have been beautifully figured by my gifted friend Mr. H. Eltringham in his fine and useful book on 'African Mimetic Butterflies': *Danaida chrysippus*, L., with its forms *alcippus*, Cr., and *dorippus*, Klug; *Hypolimnas misippus*, L., with its corresponding forms *alcippoides*, Butl., and *inaria*, Cram.; *Argynnis hyperbius*, L.; *Acræa encedon*, L., and *Mimacræa marshalli*, Trim.; *Papilio leonidas*, F., and *P leonidas* f. *brasidas*, Feld.; *Amauris ochlea*, Boisd., *Pseudacræa lucretia* f. *expansa*, Butl., and *Hypolimnas deceptor*, Trim.; *Amauris niavius dominicanus*, Trim., and *Hypolimnas dubius* f. *wahlbergi*, Wllg.; *Amauris albimaculata*, Butl.; and *Hypolimnas dubius* f. *mima*, Trim.; *Acræa zetes acara*, Hew., and *Pseudacræa boisduvali trimeni*, Butl. (figs. 9 and 10 of Plate 6 are most like the individuals used in my mimicry experiments); *Atella phalantha*, Drury, *Mylothris agathina*, Cram., *Belenois thysa*, Hopff., and *Eronia argia*, Fabr., *Pardopsis punctatissima*, Boisd., and *Pentila amenaida*, Hew.; *Terias brigitta*, Cram., and *Terias senegalensis*, Boisd.; *Nychitona medusa*, Cram.; and *Papilio dardanus* with its various mimetic females.

But carnivorous and egg-eating animals were also somewhat strikingly deceived by resemblances in their prey, and I have seen Herbivora obviously deceived too—despite their sense of smell, which is not always used where visual evidence seems convincing.

The publication of the details of my experiments has been thought to be perhaps unnecessary by one or two of my friends. To them I must still reply, and I am glad to find that Professor Poulton fully agrees with me, that the whole object of the investigation was to obtain that mass of actual evidence for or against the selectionist views of animal coloration that has so far been lacking, and which the opponents of those views have insistently, and very rightly, demanded: that the mere statement of the experimenter's conclusions is no evidence—only the detailed experiment, to be examined critically and made to yield other conclusions if the experimenter is found to have been misled through bias or error or ignorance, is evidence; and that it is only right to place this evidence on record and at the disposal of all who may at any time care to study it and draw those other conclusions if they can. Even the giving of sample experiments is no guarantee against erroneous deduction in those that are not given.

To give only one example of the very great danger attaching to incomplete publication in a matter of this kind, I may say that, with increased knowledge, I myself now draw quite different conclusions from my own first five hundred experiments from those I drew at the time. Yet five hundred is a large number, capable of forming a paper nearly as long as the whole of the present one, and had I at that time decided to publish them in full my decision would almost certainly have met with the friendly criticism it has met with to-day. The result, had I contented myself with the publication of my conclusions, would have been utterly to mislead. So now, I can be by no means sure that I have extracted all conclusions of importance that can be extracted from my experiments—I know that I have not—or that the discovery of some new complicating factor still unknown to me may not yet invalidate some part of my present conclusions. This, as I shall relate, actually happened to me not very long ago. I feel, therefore, that the only safe course is to place on record the exact details *of what the animals actually did.*

B. ARE THE EXPERIMENTAL RESULTS PROBABLY TO BE RELIED ON? *

The reader may object (very reasonably) that records of wild birds actually attacking butterflies are even now all too scarce; that tens of thousands of their stomachs have been examined, in almost every case with negative results; that where wild birds *have* been seen to eat butterflies these have very frequently indeed belonged to so-called nauseous species and that destruction by birds cannot therefore fairly be regarded as discriminative. Finally, even admitting that discrimination may take place, what proof is there that a captive bird's preferences will fairly represent those of a bird in the wild state? If a pet and in the habit of receiving dainties from its owner, may it not tend to eat on trust even unpleasant insects? With appetite and digestion impaired by fear or fretting or if stinted of its natural range of food, is it likely to be a suitable subject for this kind of experiment at all? Captive birds have eaten what they are not known to eat in the wild state and refused prey that in the wild state they have been found to eat. "Unless, therefore," the reader might conclude, "you can first satisfactorily meet these very real objections, you can hardly claim that any results you may have obtained from, at any rate, captive animals are necessarily in the least degree reliable." I would agree ; and it is only because I believe that these objections can be amply met in the way required by my critic that I have, as a matter of convenience, adopted the present order. I think it right, however, in the meantime to indicate the lines on which I would be prepared to meet the criticisms :—

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* This, and the introduction generally, was originally written in relation to the experiments with insects. *Mutatis mutandis,* a great deal of it is applicable to the experiments in which vertebrates and plants were used. A good case can be stated, I think, for the reliability of these too.

1. *Apparent reluctance of birds to feed on butterflies.* [The following was written long before my recent short paper for the Entomological Society (Proc. 1915, p. xxxii), and should be read in conjunction with it, also with my paper on the subject in 'The Ibis' (Oct. 1912, p. 635), with Mr. Marshall's paper referred to below, and my own remarks at the end of Section 2 of the present paper.] I cannot help feeling that those who have believed that birds do not feed to a very appreciable extent on butterflies have, at any rate, had a good deal of apparent justification for their opinion. The evidence supporting that opinion is of a negative character, but it is bulky. As for its quality, I should suppose that some at least of the very extensive and admirable American stomach investigations that failed to reveal much in the way of butterfly *débris* were microscopical : I do not know how completely exhaustive in relation to the very finest *débris* they were, or to what extent specially directed towards the finding of Lepidopterous remains. So far as actual attacks seen and recorded are concerned, Mr. Marshall's painstaking and highly resultful investigation showed (Trans. Ent. Soc. Lond. 1909, pp. 329–383) that these have been vastly more numerous than was generally believed : his total was close on six hundred, and very many of the records were multiple. At the same time, butterflies being as a whole the most conspicuous and distinctive of insects, and attacks by birds on less recognizable insects being a matter of such daily observation (I speak, at any rate, of my own experience), it would certainly seem significant that attacks on butterflies too are not witnessed with the greatest frequency. Mr. Marshall has suggested one or two excellent and cogent probable reasons for this lack of evidence, and I am able, from my own observations, both to confirm these and to add one or two others.

Butterflies are, in any case at Chirinda and in many other parts of the world, by no means abundant relatively to the members of certain other orders. At a time when butterflies were particularly abundant I have watched more small Diptera, etc., cross a shadow in half a minute than I have seen butterflies in the whole day ; each year I have watched the great grass-fires drive out the butterflies as single spies, but the grasshoppers in battalions ; I have roughly calculated that probably more driver-ants passed a certain spot in one hour, and that more wild hive-bees could be seen any day in April at a single one of my *Eucalyptus saligna* gum-trees in a very few hours, than the number of butterflies ever seen by me in a year—this though I have collected largely at the fruits and flowers that bring butterflies together as the *Eucalyptus saligna* flowers bring the bees.

Therefore, considered absolutely, attacks on butterflies, whenever and wherever they are thus outnumbered, are unlikely to be as numerous as those on the insects that outnumber them. Even relatively, however, butterflies are likely to suffer somewhat less than more abundant insects—that is, if my own observations and those of, I believe, at least one American observer (Mr. H. C. Bryant), to the effect that birds tend to concentrate their attention somewhat specially on what (of an acceptable nature) is at the time most readily obtainable in quantity, be correct.

These factors, with certain others not worth going into again here as I have dealt with them so recently, probably account for the otherwise puzzling fact that we do actually see fewer attacks on butterflies than on insects of certain other orders. But, at Chirinda—and I have at present no reason to suppose that the locality may be exceptional in this respect—I have obtained evidence that even if they should enjoy a certain amount of relative immunity under the circumstances I have suggested, butterflies are probably nevertheless *very greatly* persecuted, even at times by those birds that specialize primarily in other directions; and I find it interesting to contrast my results obtained during two different periods.

In eleven years, during which I paid no very special attention to the subject, I witnessed only about twenty attacks by wild birds on butterflies. In four years, during small portions of which I *did* pay special attention to it, I obtained records of over 800 such attacks. Nearly all these were witnessed by myself, the majority of them within a single month, during which I made a point of working at the subject amongst the wild birds of the forest outskirts for an hour or two each day. The method was mainly (not solely) experimental, but in many of my experiments thoroughly vigorous, unmaimed and strongly-flying butterflies were freely used, and even these drew numerous attacks. Again, during the first period mentioned, I examined, non-microscopically, more than 1000 stomachs of insectivorous birds, and in only five found butterfly remains. I later found, by the close examination of pellets the raw material of which was known to me, that butterflies, including their wings, tend to be broken up so finely in a bird's stomach that their presence is often only to be recognized by the use of a lens that will readily show the scales, etc., and their absence only to be established as the result of a completely exhaustive examination of the whole of the finest *débris*, which in some cases may take very many hours. This led me to a decision to re-examine the stomach-contents I had collected, and although up to the present, through lack of time, my re-examination has not proceeded far, the initial indications are that the proportion of stomachs with Lepidopterous remains will be higher than at first. Other lines of investigation (testing of newly captive and wild birds for previous knowledge, examination of excreta picked up at random in the forest, etc.) have all produced results pointing in the same direction. It is perhaps yet more important, for it is this that best enables us to judge of the *extent* of such persecution as is suffered by butterflies, that I have obtained good direct evidence in favour of the view that it is birds that probably chiefly inflict the wounds that are present sometimes in the wings of nearly every fairly high-grade butterfly one sees.

2. *Discrepancies between the attitude of wild and tame individuals of the same species towards the same food.* In animals (and especially, amongst birds, in hand-reared nestlings) that have become accustomed to a particular kind of food I have often noticed the growth of a kind of conservatism that makes them reluctant after a time to try new foods, even foods that are eaten freely by other individuals, wild or captive, of the same species—and I shall describe, when I come to it, a particularly good contrast of this kind that occurred between two of my captive bulbuls.

I shall also have much to say, even in this introduction, of exactly the opposite phenomenon—namely, the tendency of animals accustomed to a wide range of food to develop special eagerness for food of which they are largely deprived and relative indifference or even repugnance to the foods they chiefly receive.

These two principles I have seen illustrated at different times even in a single individual (a lemur, *Galago crassicaudatus*) and, with that to be described in the next paragraph, they have seemed to me to be largely capable of accounting for, at any rate, such cases of apparent discrepancy as I have myself come across.

3. *Apparent indiscriminateness of wild birds.* My experiments on wild birds (at any rate) show that it does not require, necessarily, literal starvation to make a bird eat Danainæ and Acræinæ: a mere empty stomach (in some birds rather less)—combined with a good hungry appetite—may suffice. When it has eaten a little food it will refuse insects of this very low grade, but accept others which will in turn be refused with growing repletion, though insects that are a little pleasanter will continue to be taken: and so on, through several grades, up to actual repletion-point, near which only the very "pleasantest" insects of all will be accepted. This is a statement which my experiments will be found to support in the most ample manner, and the fact stated will probably in most cases account for the frequent eating of low-grade insects by wild birds; for the refusal sometimes by captive birds of food that the species is known to eat in the wild state and *vice versa;* and for much that might be regarded as inconsistency on the part of captive animals. I could give many instances of the working of the principle, but the following must suffice:—

(*a*) *Flocks of wild bee-eaters* (Merops apiaster) *may daily be seen eating immense numbers of hive-bees, and I have taken as many as* 23 *from a single* *stomach; yet a captive bee-eater refused to touch them, emphatically and repeatedly, though she readily accepted and ate certain other insects.*

This observation by itself would be most puzzling, and might well help to discredit utterly experimentation on captive birds—as might any one of various other observations of exactly the same kind that I have in mind. Yet my bee-eater only thus refused bees when a certain point in the satisfaction of her appetite had been reached. Up to that point I found that she ate them readily, and careful and repeated observations on numerous wild bee-eaters of the same species (*Merops apiaster*) showed that they too apparently only ate hive-bees up to a certain point, thereafter ignoring all they were seen to meet, but attacking and eating various other species of insects.

(*b*) *I have myself accused rollers of being, probably, indiscriminate feeders on the strength of such strongly-smelling insects as the grasshopper,* Phymateus, *having been found in their stomachs and because a roller in my aviary* (Coracias olivaceiceps) *accepted and ate them on several occasions with apparently the greatest relish.*

I had no knowledge of the state of repletion of the latter roller, nor could I possibly know the exact state of hunger or otherwise of the wild roller whose stomach was examined, at the moment each ate his *Phymateus*. And I now realize that, without that knowledge, I was utterly and completely unjustified in coming to any conclusion at all, either as to the insect being highly pleasant or the roller indiscriminate. Offered to *C. garrulus* (B), the *Phymateus* was eaten, it is true, but only up to a certain point in the satisfaction of the bird's hunger, and not beyond it. The finding of a particular insect in the stomach of a wild bird, even frequently and in large quantities (as in the bee-eater instance just given), at most proves that that species of bird will eat it when hungry enough. It in no way invalidates such conclusions as may be suggested by the rejection of the same insect by the same species of bird, captive or otherwise, when it is *not* hungry enough for it, yet *is* hungry enough for certain other species of insects. It can be seen, too, from what I have said, how futile any attempt must be to deduce the status of, say, the Acræinæ used in any series of experiments by merely counting up their total rejections against their total acceptances. If they were offered mainly to hungry birds the acceptances probably would be more numerous than the rejections, but this would not indicate that the Acræinæ are as digestible as things eaten to nearer repletion-point, or that they would ever be eaten at all under conditions other than those under which they were offered—a nearly empty stomach and a rousing appetite.

Stomach and pellet investigation must, I think, remain our greatest and most valuable source of information with regard to the *general* preferences of a species, the orders it usually feeds on, and the insects it mostly "fills up" on, as a bee-eater does on bees. But facts like the above seem to indicate that our knowledge of its detailed preferences must come in the main from continuous observation of individual unconfined birds and from special experiments both on wild birds and on captives *.

Experiments on wild birds are obviously quite indispensable, if only as a check on the others, but on captive birds they can be carried out in far greater numbers, with greater ease and precision, and with fewer insects than are required for wild-bird experiments, so that it certainly seems well worth enquiring whether, conducted with care on suitable birds, suitably fed and looked after, they need really be so very unreliable. The factors, apart from lack of exercise and limited choice of food (with both of which I will deal later), that would render them unreliable, seem likely to be :—Fretting, ill-health, fear, suspicion or (the opposite) over-confidence.

An animal that mopes, whether from ill-health or rebellion at confinement, and continues to mope, is useless for experiment of this kind—and often unusable. As might be expected—for even with ourselves ease of mind is a condition of good digestion,—its appetite is lacking or so capricious that it is frequently quite impossible to assign a value to its acceptances or refusals. The variation in individual animals, even of the same species, is sometimes great. Thus of two kingfishers (both *Halcyon cyanoleucus*), one at once took most kindly to captivity, showing no appreciable fear of me when I approached his cage, and, on my offering him various insects with the forceps little more than an hour after his capture, accepted and ate them most readily. The other (captured at a later date) fluttered to get out, and when it finally gave this up, simply pined away, refusing food or accepting it only in small quantities and capriciously. I have had similar experiences with a few other birds, with a lizard (*Agama* sp.), and with a toad. Needless to say, I claim no reliability whatsoever for the "results" obtained from these animals.

The restlessness that is sometimes present for a few days after capture (or—at any rate, if not confined to the night-time—that which appears at migration-time) is also a form of unsettlement that is inconducive to consecutive and therefore reliable experimentation. Fear of the experimenter falls into the same category so far as its result is concerned, but its continuance for more than the first few days will in many cases (if I am safe in judging from my own experience) probably be the fault of the experimenter. I have found that the persistent quiet offering of pleasant insects through the bars by the forceps to newly-captured birds has in all but very intractable cases sooner or later evoked a response. This is usually at first a timid one, but, once it has been obtained, a little more persistence on my part has almost invariably soon begun to win the bird's confidence. Delay in obtaining this has usually been simply the result of my being unable to devote the necessary time to the bird.

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* These and certain other opinions offered in this introduction I hope to state in greater detail and with such qualifications as may be necessary at a future date.

Suspicion of the food offered is another condition during the continuance of which any results that may be obtained must be duly discounted. Again, judging simply from my own experience, it is likely, I believe, to be due usually to lack of tact on the part of the experimenter. Thus the offering of a number of highly unacceptable insects without a good admixture of more acceptable species to a bird that is just learning to take from the forceps would be a mistake. My baboon afforded an extreme instance of this suspicion, the result, apparently, of my having offered him unacceptable insects hidden in balls of dough, and I have noticed that trickery in any form—such as disguise by the attachment of another insect's wing—tends, where detected, to produce temporarily a suspicious frame of mind in previously confident birds. Usually I have found such suspicion to be quite transient. It is also, as a rule, readily recognizable and can be allowed for.

Over-confidence is likely only to take place in an over-petted animal that is continually being offered dainties by hand, and even in it only during the first experiment or two in which any number of unpleasant insects are used. It is, in any case, unlikely to be present in a bird that has already had ample experience of unpleasant insects in the wild state.

To sum up on these few points :—Fretting, ill-health, restlessness, fear of the experimenter, suspicion of the food offered or over-confidence, are each and all perfectly capable of vitiating the results of any experiment throughout which they are present. This certainly constitutes an exceedingly strong plea for care in the treatment and selection of the animals to be experimented on, but I am not at all sure that it is any more a valid argument against "captive" experimentation generally than the fact that some charities are undeserving of attention is an argument for refusing to contribute to charities at all.

Some individual animals are refractory under confinement, or otherwise unsuitable for experiment. These should not be used (or, if they *have* been used, should not be regarded as necessarily reliable). Others, even though captured when adult, take confinement very placidly, soon become thoroughly friendly with the experimenter, feed well, and keep in excellent health and condition. Birds of this stamp seem to me likely to be useful subjects for experiment in captivity—always subject to the difficulties, yet to be discussed, connected with food and exercise. Amongst others of this kind were my chief European roller (B), my kingfisher, my shrike (*L. collaris*), and my drongos.

4. *The food difficulty.* I have from the very first realized the importance of this and have made it a point that the food should be abundant, varied, and so far as possible natural. One special native always (occasionally two)—chiefly when Diptera or hive-bees were wanted in special quantity, as for the swallows, drongos, and bee-eaters—has done nothing else all his time but catch various insects for the birds. This quite apart from any native (or

myself) who might be collecting butterflies, etc., for the actual experiments. The following statement will, I think, show that for the few birds to which I confined myself at any one time it was possible, even with this small amount of assistance, to do a good deal in the way of variety.

Our commoner Orthoptera—Locustids, Acridians, Crickets, Mantises, etc., in great variety—have usually formed the daily *pièce de résistance* for such birds as cared for them (that is to say nearly all), while portions of termite-nests containing commonly, in addition to the ordinary workers, which were not liked, females and larvæ, which were more readily eaten, were placed daily, broken up, in the trays, the latter having been first filled each morning with leaf-mould and rotten wood. This was brought straight from the forest close by, and often contained much small insect-life of a kind that would have been difficult to obtain otherwise. It had to be discontinued in wet weather owing to its making the cages too damp. These foods were constantly supplemented by such other abundant insects as happened to be in season, as cockroaches, migratory locusts, both larval and winged, an Asilid fly (*Alcimus rubiginosus*) that is abundant during the spring and summer, house-flies and other Diptera, as also hive-bees, rewards being given to natives bringing me the latter insects in any quantity during my time of greatest experimentation with bee-eaters and drongos, the abundant and gregarious ant-lion imago, *Formicaleo leucospilus*, dragon-flies (*Orthetrum* spp.) when plentiful, winged termites, *Sphingomorpha chlorea*, *Nyctipao macrops*, *Cyligramma latona* and other common Noctuidæ—and so on. Of the moths, the *Sphingomorpha* has been sometimes so abundant on the banana-branches hanging in the verandah and on fallen guavas or other fruit as to enable a one-pound tea tin to be filled with them evening after evening in the space of perhaps half an hour.

Of butterflies, *Charaxes brutus* and *C. candiope* have also sometimes been so abundant as to enable me to feed them to some extent to the birds, and it will be seen that during a portion of the time when I was experimenting on swallows, I was able to give them *Pyrameis cardui* in such numbers that it proved quite a large item in their daily food. Coleopterous food in the adult state—that is, of species that the bird would have eaten—would have been difficult to obtain in any great variety without the employment of much additional labour, but *Neptunides polychrous* and other Cetoniidæ were collected during their seasons of abundance, killed and thrown in to the larger birds, *Anomala* and the other Rutelid beetles that are such a pest to our gardens were supplied in numbers, and such larvæ, mainly Coprids, as were dug up in the garden or could be obtained from manure-heaps were also given.

The Coprid larvæ were disliked, but a few might be eaten if placed in the cages (as they usually were) before other food had been supplied. The larvæ and pupæ of the Cetoniid beetle, *Rhabdotis aulica*, on the other hand, were far better relished by all and were eaten in considerable quantities, being obtainable in abundance from the sheep-sheds. Special consideration in the matter of variety was given to those birds that were being chiefly experimented on at the time, and sometimes numbers of spiders and insects in great variety, including numerous Diptera, would be obtained by "sweeping" and thrown in to them.

The known tastes of the birds were always, so far as possible, consulted: thus the swallows had a special boy of their own whose one business it was to catch Diptera. The Barratt's bulbul (*Pycnonotus flavistriatus*) was specially supplied with wood-lice and such other subcortical species, spiders, etc., as I could obtain for it in the forest (its habitat), also with the fruits of *Celtis dioica*, S. Moore, a fruit I have frequently taken from the stomachs of wild individuals of the species. The other bulbuls received bananas, papaws, guavas, oranges, and occasionally other fruits in addition to their insect-food, and occasional meat-eaters, as the roller and shrikes, sometimes received a dole of meat or a lizard, a mouse or a bit of snake.

The owl received chiefly meat, but also insects, especially during periods of experiment, and the buzzard-eagles both meat and insects, especially quantities of migratory locusts which were abundant in their time. Naturally during long periods of no experimentation my efforts in the direction of variety were also relaxed—extra help was discarded, rewards were not offered, sweeping and all other special methods were dropped: yet even then the bird-boy, whose sole daily work it was to clean the cages, provide ample water, and catch insects for the birds' food, used to bring in the latter at such times mainly (but by no means entirely) Orthoptera, in great variety. I have on one or two occasions (I will mention them in describing my experiments) had to recommence experimenting on a bird that had for some time previously been receiving its food in this rather more limited variety. I have, I think, noticed no departure at such times from its usual preferences *provided it was suitably fed during the few hours preceding the experiment.*

The precaution italicized is at times an exceedingly necessary one. I have known a guinea-fowl tired of grain and a bulbul tired at one time of fruit, at another of insects. My drongo (since I ceased experimenting on him regularly) has shown "vitiation" in the form of increased eagerness for certain orders of which he has been largely deprived and a corresponding slight repugnance to those he has been chiefly receiving. My experiment of August 30th, 1913, affords a very perfect illustration of this. The drongo, having been deprived of Lepidoptera for some weeks, and having developed over-eagerness for them and disinclination for, in particular, Orthoptera, was fed for nearly a whole day on Lepidoptera alone. This was enough to tire him of them and to create a fresh eagerness for Orthoptera. The experiment —to "place" the butterfly *Crenis rosa*—was consequently unsuccessful.

Similarly, my rats, and, at one period, my lemur, would be so ravenous for animal food after being deprived of it even for a day or two that their usual discrimination in relation to it vanished and they became, till their meat-hunger was satisfied, nearly useless for experiment in that particular direction.

As the result of my general experience, I would lay it down as, at any rate, a safe rule: "To ensure thoroughly reliable results provide a mixed diet and include as a fairly important item the order of insects with which it is proposed to experiment." Wherever, however, experimentation is on a sufficiently large scale and fairly continuous, the material used in it should alone be sufficient to obviate over-eagerness and too great lack of practice.

Further points. I made a point of always (four times a day) placing the birds' food in their trays myself and also of chatting much to them, with the result that they quickly became very friendly with the experimenter. At the same time, after the initial taming, I avoided the continual offering of dainties by hand, and would allow even their ordinary food to contain a certain proportion of such highly unpleasant insects as the bird might most frequently meet with in the wild state (as the grasshopper, *Lentula*, and the Meloid beetle, *Mylabris*). The cages were wire-fronted packing-cases, with the result that no bird could see what those in the other cages did; and, further, no complications arose with regard to the possible removal of insects by ants or the birds' attendant, excepting, I believe, in one unimportant instance. The cages were in proportion to the size and importance of the bird (the owl even having a whole small shed to herself); they were kept, when not in the sun, in a dry, airy, sheltered verandah, and they were cleaned out daily. Each bird, except where otherwise stated, had a cage to itself.

It may still be objected that however successful the experimenter may be in ameliorating its conditions, confinement must necessarily remain a highly unnatural state for so active an animal as a bird. It is still, therefore, exceedingly possible that my birds did *not* display the same preferences as they might have done in the wild state. I fully admit the possible justice of this criticism, and all I have left to reply to it is this:—

1. Each sufficiently tested bird was found, on the whole, to be exceedingly consistent.

2. There has been quite a strong general agreement in the order of preference, not only between individuals of the same species, but between different and quite unrelated species—so unrelated as a butcher-bird, a drongo, various Picarians, an owl, a hawk, and a francolin; also not only between the various birds themselves, but between these and a monkey, a chameleon, a beetle, an Orthopteron, a dragon-fly, and an Asilid, *in so far as these latter animals have been tested.* Thus Acræinæ (and certain beetles) have *always* been placed very low, *Mylothris* (and certain moths and grasshoppers) always just above them, *Belenois* and some Lycænids always next, and other Lycænids and Pierines and some Nymphaline and Satyrine genera and a skipper (*Cyclopides*) above these. Finally, came the yet higher grades, which included various

Nymphalinæ and skippers, *Catopsilia*, various grasshoppers and Noctuids, etc. I think that the only striking exception was in the case of our commonest bulbul (*Pycnonotus layardi*). Two birds of this species that I tried both tended to place Pierinæ generally particularly low, and one of them at any rate placed Danainæ unusually high. This departure from the more usual order may, of course, have been a case of vitiation due to captivity, but I should rather hesitate to accept that explanation myself. It is more probably a case of specialization—or, if the peculiarity be confined to individuals, it may be analogous to the differential results on the natives who eat them of the larvæ of the moth *Anaphe panda*.

I would in any case like to make it quite clear that I am not referring to the larger preferences as between Orders. Thus, if any species specializes on Diptera, it is likely to place these insects generally far higher than will a bird that is not to the same extent a Dipteron eater : *cf.* the contrast in this respect between my drongos and my rollers.

3. Newly-captured birds have, in so far as their preferences have been ascertained, confirmed long-caged individuals, with only the occasional and relatively slight transpositions that may be expected even between two wild examples of the same species. In this connection Roller C's list may usefully be compared with that of Roller B.

4. My tame ground-hornbills, roaming always unconfined and not fed at the house at all, had much the same preferences, in so far as they were ascertained—as, *e.g.*, my captive rollers.

5. Such preferences as I have elicited from wild birds—and they have been fairly numerous—also go to bear out the views of my captive birds.

This is the case for the *reliability* of my experiments. I will now frankly state those points in which I believe them to be *not* entirely reliable.

1. *Through relative lack of exercise.* I have evidence—not conclusive, for the species were not the same, but certainly I think fairly strong—in favour of the view that unconfined birds, probably with the digestion born of exercise and of general greater enjoyment of life, may more readily and frequently become hungry enough to eat highly indigestible insects than even non-fretting captive birds. This, as will at once be seen by a study of my experiments on them, is not equivalent to saying that they do not discriminate, or to saying that the order of their preferences may not be approximately the same as those of captive birds of the same species.

2. *Through relative lack of practice.* It being obviously impossible, however much trouble one may go to, to provide the *full* amount of practice enjoyed by a wild individual, mistakes from lack of it are likely to be especially frequent amongst captive animals.

Mistaken tastings, for instance. Not that for the purpose of these experiments anything but mistaken *eatings* matters, for a rejection is as good as, or better than, a refusal; and mistaken eatings are rare even amongst captives, so accurate and instinctive does the judgment by taste even among young birds become after a very little practice.

Mistaken refusals too. Thus it seems quite probable that, given an equally perfect view, a wild bird would, as the result of greater practice, distinguish between the commoner models and mimics somewhat more readily on the average than did my more long-caged birds. Yet, as I will show, even wild birds are deceived—and they seldom have so good a view as I used to go out of my way to provide for my captive birds.

3. *Through surfeit in a particular direction.* I have had cases—very few indeed that mattered—in which probable over-eagerness for a particular order has been displayed. To these cases I will draw special attention as I come to them.

The above are three difficulties that are likely to confront even a careful experimenter on captive animals. The first two can be partly remedied and entirely allowed for, and the third can be remedied: none of them need be allowed to vitiate one's deductions in any appreciable degree.

A fourth difficulty is worth stating here, though it has certainly had no especial connection with captivity. The animal experimented on would sometimes appear suddenly to awaken to a realization of greater appetite; it would fall back (sometimes with an actual "brisking up" of manner, which at once gave the clue) to a point already left behind and once more begin to take things that were already becoming unacceptable to it. Even amongst my insectivorous birds this was probably in most cases equivalent to that marked increase in appetite that I later found it possible—and useful—to provoke at will in my carnivorous animals by the offering of something sufficiently pleasant to stimulate, it would seem, a flow of the digestive secretions. Conversely, repletion—or the symptoms of it—might be produced prematurely by the eating (in, at any rate, one of my mammals merely the smelling) of some unduly indigestible species of prey.

To this phenomenon—the sudden stimulation or inhibition of the gastric secretion—may be attributed, I believe, nearly all the cases of apparent inconsistency that have occurred in the course of these experiments. Its occurrence demands increased caution in the deduction of preferences generally, but, as I have said, there seems no reason to suppose that it is a phenomenon peculiar to or aggravated by the captive state.

In conclusion, it must in all fairness be acknowledged that the only *absolute* proof that a captive animal's preferences are the same as those of that animal in the wild state would be that afforded by a testing of the preferences of a single individual, (1) in the wild state, (2) after capture; and I have often regretted that it did not occur to me to attempt this in the case of my wild bush-shrike (*Dryoscopus guttatus*). But even the evidence I *have* obtained (and referred to above), namely a rough general agreement between unrelated species in captivity and, yet more important, the rough confirmation of these captives' preferences by wild individuals, albeit of other species, seems to me to be of a particularly cogent nature.

C. METHODS OF EXPERIMENT AND DEDUCTION.

The plan on which I started (on Dec. 6th, 1908) was as follows :—

First to offer each of my captive animals as large a series as possible of every available species of butterfly, and then, having thus ensured an adequate knowledge of their butterflies by these animals, to carry out on each a series of preference experiments by repeatedly placing together on the floor of the cage a few freshly-killed butterflies of different species and noting which were chosen.

For a time I was less successful than I had hoped, though, clinging at first to certain preconceived ideas and as yet knowing little of the factors that should have been allowed for in shaping the experiments, I did not realize this then. I *now* find many of my earlier experiments very disappointing reading indeed, and it is with a feeling of surprise at my own slowness and ineptitude that I realize that I largely wasted five months (Dec. 6 to May 11), 534 experiments, and many thousands of butterflies in merely learning to experiment. For it was apparently only towards the latter date that I was commencing to realize at all sufficiently the vital necessity for keeping in some sort of touch throughout an experiment with the state of the animal's appetite. It is also possible that the scale on which I attempted my series-offering constituted rather a counsel of perfection : at all events, from one cause or another, it was only in the case of a small proportion of my earlier animals that I ever arrived at the second or true preference-experiment stage.

Finally, the above-described method of preference experiment seemed when I first tried it to lead to results as difficult of interpretation as those that Colonel Manders (Proc. Zool. Soc. London, Sept. 1911, pp. 696–749) obtained by the same method in Ceylon. I have since (by repeated observation on several species of birds, wild and tame, and one mammal—*Petrodromus tetradactylus*) found the explanation to be that an insectivorous animal, given a choice, either fails to exercise it, as between the things he is hungry enough for and merely picks up each as it comes, or, when he does exercise it, tends to select the *largest* object that he is at the moment hungry enough to eat: were he hungry enough for *Amauris dominicanus* he would probably take it in preference to *Precis cebrene*. When this is realized and allowed for, this method, first suggested to me by Mr. Marshall, is not only exceedingly useful but probably the only one that can in most cases be satisfactorily employed in dealing with wild birds. I had, however, in any case attempted very little in the way of preference experiments at all before May 12th, 1909, when I commenced a short series of experiments on one of my buzzard-eagles (*Asturinula monogrammica*), in the course of which I evolved what is now my more usual method of eliciting preferences.

This method, apart from its general ease and sureness and its capacity for being combined with the offering, where necessary, of large series, itself incidentally keeps the experimenter in touch with the state of the animal's appetite and possesses the further inestimable advantage of *practically eliminating the personal factor*. There is no absolute need to mention the animal's manner: the bird's acceptance of one insect immediately after the refusal of another is usually enough to indicate their relative value in its estimation. Thus where an animal, hungry after a fast or empty after voiding a pellet, eats Z but (after, say, a grasshopper) refuses a second Z yet eats a Y, refuses a Y but eats an X, refuses an X but eats a W, and so on up to A, a second or third individual of which species he rejects or refuses, while treating in the same way an insect that he has been found to eat habitually with eagerness up to actual repletion-point, there can be no difference of opinion amongst even a hundred spectators of the experiment. All, whatever their bias and however differently they might have construed the bird's manner of acceptance or rejection, are likely to agree, on the whole, that A (in spite of the bird's final repugnance to it) is probably a great favourite and Z (in spite of the eagerness of the first acceptance) very much the reverse, and that the bird's preferences, in so far as they can be judged from that single experiment, are probably in alphabetical order. Should these results have been repeated in subsequent experiments, perhaps in very many subsequent experiments and at varying intervals of time, and sufficiently checked by changes in the order of offering, the probability of their truly representing the bird's preferences will have been increased to something like a certainty. A complicating factor that I have already referred to—the stimulation of the appetite by a very welcome offering or its inhibition by a very unwelcome one—will, of course, have to be watched for, but I have found the latter, at any rate, of less importance here than in the case of my carnivorous mammals.

It is on results obtained by the above relatively mechanical method that I have placed my main reliance. At the same time, as will be seen, I have not hesitated, in numerous instances, to base deductions on the indications that are so often afforded by an animal's manner. This method is less reliable than the other in that it affords an opportunity for the entry of differences of opinion and unconscious personal bias, but, used with due caution (as I have, I hope, used it) and especially with a knowledge of the state of the animal's appetite (for without this it is useless), it becomes after practice far too valuable a source of evidence to be entirely neglected.

I would go further, and say that without a knowledge of the animal's state of appetite (best gauged by what of known value the bird will or will not at the moment accept) it is not only useless—it may be hopelessly misleading. A bird will frequently reject with, apparently, some disgust an object that if slightly hungrier he would have eaten with apparent relish; he will sometimes when quite replete reject even his greatest favourites with signs of displeasure, or when really hungry accept the most "nauseous" insects with every gesture of eagerness: and it is only when the experimenter is aware how hungry or otherwise the bird is that he will know just how much value to attach to these demonstrations.

Some of these actions have obviously in themselves no relation whatsoever to the animal's likes and dislikes—such as the battering and the mastication referred to above: yet (as I have indicated) they are well worth watching for the manner in which they are performed. In this category comes the wiping of the bill. It is a very usual action after food has been eaten, particularly if it has required much preparation and left juice or fluff on the bill. It may even be continued at intervals, as I have seen, for some time afterwards, and, I fully agree, does not necessarily indicate the very smallest dislike of the object swallowed. Yet there is a wiping of the bill—and it is not, I think, always very difficult to recognize for the experimenter who has come to know it—that does seem to indicate dislike (when an insect has been tried), and there is also a wiping of the bill that may accompany refusal without trial. With my kingfisher and at least two of my bulbuls this form of refusal (without tasting) of a proffered insect was by no means unusual, and it occurred in other birds too; and I have on a few occasions, by merely holding up a very low-grade insect in view of all the cages at a time when the various occupants were by no means hungry enough for it, produced the simultaneous vigorous wiping of several bills. I have seen my kingfisher thus wipe his bill repeatedly when an *Amauris albimaculata* or *lobengula* merely entered the verandah and remained flying about in it for two or three minutes: it was one of the methods adopted by my older wood-hoopoe (*Irrisor erythrorhynchus*) apparently to dissuade a younger bird from eating a *Danaida*; and much bill-rubbing is sometimes indulged in before and in the intervals of attempts to bring up an insect, the eating of which has resulted in nausea. This last instance indeed would seem to suggest that there may be a simple physiological explanation at the back of all these cases of bill-wiping, namely, the abundant reflex secretion of saliva that at any rate in man and certain other mammals is known to accompany actual nausea or the sight of objects that experience or training has suggested to be of a nauseating character. From cases like that of the wood-hoopoe one might even suspect, were one inclined to theorize, that as spitting in man has gone on from (quite possibly) this beginning to become a conventional sign of contempt, so bill-wiping may have become stereotyped in some bird-languages as, *inter alia*, a signal of unacceptability or warning.

That there are cases in which it is by no means easy to decide between two or more possible motives it would be foolish to deny. Thus I at first tended largely to put down to grave suspicion actions that I have since learnt to attribute in most cases to mere disinclination—or mere initial caution. Even to this day, as will be apparent from some of the experiments to be described, I would not feel at all certain of being able to distinguish between these two motives in every case.

Number of Trials, etc.: It will be seen that the results of single trials in these experiments have been sometimes by no means final, and that I nowhere place the same reliance on them that I do on the mutually corroborative results of several trials. It was in order to avoid so far as possible the suspicion that must necessarily attach to single tastings that the experiments were, as already indicated, attempted on a fairly large scale. Again, in numerous instances (indicated often by the word "persistently"), I have offered and re-offered and *re*-offered even an individual insect with the greatest insistence in order to make sure that its refusal was thoroughly genuine and well-considered. And throughout I have obtained that consistency of result and that same general range of preferences from Acræinæ, etc., upwards that I have referred to earlier.

My method of offering, I ought to explain, was, unless otherwise stated, to bring each insect up close to the bird's bill (or mammal's mouth), usually by the forceps. This ensured a definite acceptance or refusal—there was no possibility of the insect remaining unnoticed. It was, of course, impracticable in the case of the wild birds.

"Inedibility"; "Unpalatability." For reasons which will, I think, be appreciated by anyone studying these experiments, I cannot help regarding the use of the terms "edible" and "inedible" without qualification as somewhat highly misleading. It is true that a large *Brachycerus* is inedible to a bulbul, and even to a roller, but it is not inedible to a bird, large enough to swallow it, whose bill is capable of crushing it (e. g., *Bucorax*), or whose digestive apparatus is capable of dealing with it uncrushed (e. g., *Numida* . An *Amauris* or *Acræa* is unacceptable at most times to insect-enemies generally, but it is by no means "inedible." Given the appropriate degree of gastric activity it may even be highly acceptable to any of them. The difference between it and, say, a *Precis cebrene* is probably simply one of frequency of attack, but that difference may be a highly important one. Thus, even though it be itself very frequently attacked, a species that is only acceptable when the crop is empty is likely (other things being equal) to be considerably less frequently attacked than one that is acceptable at all stages; and even this advantage is sufficiently obvious to render it intelligible that it may be of benefit to the latter insect to be sometimes mistaken for the former. For how great the benefit might be, see (for example) experiment 29, in which no less than 40 butterflies, including 14 large *Charaxes*, were eaten by Roller B after she had tried and rejected a *Mylothris agathina*, and 37 butterflies, including 12 large *Charaxes*, after her similar rejection of a *Terias*. I could multiply instances as striking or possibly better, and there is nothing I think that more vividly brings home to one the reality and probable importance of the defence that is known as unpalatability.

To illustrate, however, my remarks on "edibility" (and incidentally to supply the reply to a question raised by Mr. McAtee), I may say that my shrikes not only ate when sufficiently hungry such very low-grade insects as *Mylabris* and *Zonocerus* (often, it is true, with many signs of dislike), but would even, when insufficiently hungry for them, impale them sometimes for future use. If one were taken off the spike and re-offered they would reject or re-impale it, and yet immediately after doing so they would, given the chance, make a large meal off certain other insects. If they were now offered one of *these* when becoming too replete for it and no spike were vacant, they would often remove and throw away the *Zonocerus* or *Mylabris* and replace it by the higher-grade insect, and this in turn might be replaced later by a still more welcome species. I have never seen the order reversed. My cat, even when hungry, would similarly continue for some time to play with or often re-visit a "nauseous" bird or small mammal for which he had no present use and would eventually perhaps eat it—his appetite seeming to be gradually stimulated by the playing with it. But he would in the meantime at once relinquish it if offered more acceptable prey and would make an immediate meal off the latter. The last remark also applies, roughly, to my owl. She, too, would otherwise hold for a long time prey too low-grade to be of use to her in her then state of appetite, thus seeming to show, like the shrikes and the cat, that she realized that it would become perfectly edible under certain gastric conditions that had yet to arrive. Not that either birds of prey or butcher-birds are continually killing animals that they are not at the moment hungry enough for, however provident they may sometimes show themselves over them when they *have* killed them. So at least I would conclude from the very numerous refusals that I have witnessed on the part of hawks and *Lanius* in the wild state and from the fact that with my captive birds of the latter genus rejections were far more numerous than impalements.

Whether the term "unpalatability" sufficiently describes such protection as is possessed by an *Acræa* or *Zonocerus* I will discuss fully in finally summing up the results of my experiments. I have, I think, a good deal of evidence in favour of the view that smells and tastes, like appearance, are of use in averting the eating of their possessor mainly when they have become associated in the enemy's mind with unpleasantness of a more fundamental character. This is probably, in most cases, indigestibility, greater or less, conquerable by a greater or less degree of gastric activity.

Possible errors and past mistakes: The working out (and in most cases re-casting) of the conclusions from the different preference experiments has, owing to pressure of other work, been spread over a very considerable period and has at all times been greatly interrupted. It is very possible, therefore, that, in spite of care, mistakes may be present. Should any such be detected by my readers, I should be grateful if they would kindly draw my attention to them. The main method of deduction has been explained already: it is based on the assumption that if B is refused but A then eaten, A is probably (other things being equal) at that moment preferred to B. If A had been first eaten and B *then* refused, the probability would have been that A was at any rate not appreciably *less* liked than B. It would be unsafe to go further unless a marked difference in manner justified it.

Again, it will be noticed that up to a fairly late date in May, 1909, by which time I was beginning to adopt more critical methods, the experiments (as I now interpret them) were very barren of results. I have already stated the reasons for this. In this relatively unproductive category come all the experiments on Roller A and approximately the first fifteen on Roller B. At the same time the further advance from even my later experiments on the latter bird and on C to my latest experiments of all, to be published in a future paper, was probably nearly as great, for it was not until this latest period that I realized the effect on appetite of "the preceding offering" and shaped my experiments accordingly. "Refused A ate B, refused A ate C, refused A ate D" now takes the place of "refused A, ate B, C and D," B's possible stimulatory influence making it not quite safe to infer from the last formula that C and D as well as B were preferred to A. Much evidence that at the time I had regarded as good is thus rendered doubtful and I am refraining from using it.

As for the discarded conclusions from my very early experiments, I freely confess, for any who may still find preferences hard to believe in, that I too at first started out, not, it is true, with a disbelief in "unpalatability" (for, amongst other things, I had had the advantage of witnessing some of Mr. Marshall's experiments in 1899 on animals of my own), but at any rate with much confidence, founded on what then seemed good evidence, that very little unpalatability would be found to occur in our *Satyrinæ*, *Nymphalinæ*, *Pierinæ*, or Lycænidæ. I confess further that it took quite a good deal of evidence to convince me of the contrary, the rejecting animal being always, I could not help for a time suspecting, "in a capricious mood" or "reckless," or perhaps "unsuitable"—at any rate, anything rather than right. I suppose that nearly every investigator of such a subject is likely at first to pass through a shorter or longer "refractory" stage of this kind before he shakes off his first opinions and, throwing everything into the melting-pot, begins to learn.

It will be seen later that this was not the only idea of which my animals soon disabused me, and, as a complete cure for too great confidence in any particular view, I can thoroughly recommend a good long course of special experimentation.

For the explanation of the few abbreviations that, to save space and endless repetition, I have used in the course of this paper, I must refer the reader to the end of my introductory note to Section 3, and, again, to the commencement of Experiment 494.

NOTE.—I had already long drafted this introduction, with its reply to a hypothetical critic and its description of the precautions taken to render the experiments and their interpretation as reliable as possible, when my "critic" suddenly materialized. For I was lent by Mr. Marshall a copy of Mr. W. L. McAtee's very comprehensive if somewhat overvigorous criticism (Proc. Ac. Nat. Sci. Philad. 1912, pp. 281-364) of "The Experimental Method of Testing the Efficiency of Warning and Cryptic Coloration in protecting Animals from their Enemies."

Having read it, I decided, for the sake of completeness, to expand my original statement by the inclusion of points raised by Mr. McAtee that had not occurred to me as difficulties, but of which it seemed to me that my experiments had in any case supplied the explanation, and I hereby gladly acknowledge my indebtedness for them. I have, I think, omitted none of any importance, and I believe that Mr. McAtee, in view of the facts stated and yet to be published that were not in his possession when he wrote, is likely to be the first to agree that the experimental method is perhaps less unreliable, and those on whom he chiefly concentrated his criticism less indifferent to the necessity for abundant evidence than he had supposed, that the "strongly contradictory conclusions different experimenters have drawn" (p. 357) were probably merely the result of their not having carried their experiments quite far enough, and that any unintentional misinterpretation that may have resulted from the same cause has been, at worst, by no means confined to those who favoured the selectionist view.

2. EXPERIMENTS ON CAPTIVE EUROPEAN ROLLERS (*CORACIAS GARRULUS*, Linn.).

A. INTRODUCTION.

1. *Probable food in the wild state.* We have four species of *Coracias* (and one of *Eurystomus*) at or near Chirinda, and of these *Coracias garrulus* is usually by far the commonest during its stay.

The other three species are apparently residents, and the four together (or even *C. garrulus* alone while here) are probably sufficiently numerous to contribute somewhat to the selective factors operating on whatever insects they chiefly prey upon.

Migratory locusts, both larval and winged, various grasshoppers (including *Phymateus*), Locustids, weevils and other beetles including *Anthia pachyoma*, lizards, small snakes, mice (the natives often bait their roller-traps with these), crabs, centipedes, scorpions, cicadas, Mantidæ, fly-maggots, and termites have been found by various observers in the stomachs of birds of this genus. At least three of its local members possess much the same feeding-habits, remaining perched on the summit or on one of the more prominent side-branches of a tree or shrub, quietly waiting for their food to pass. Probably more often than not it is a beetle or grasshopper wandering over the ground that is pounced on, but migratory locusts are followed and captured on the wing:

I have several times seen *Coracias caudatus* take up its position on successive low trees close to a grass-fire and thence dash in often successful pursuit of the various insects that were flying desperately from the flames; and I have seen *C. garrulus* display such dexterity in capturing an active insect on the wing that I should not be entirely surprised were future observation to confirm Mr. Bryden's statement ('Nature and Sport in South Africa,' p. 64) that "Rollers are great hawkers of flying insects, especially butterflies." Marshall (Trans. Ent. Soc. 1909, pp. 360 and 369) gives four separate instances, including the quotation from Bryden, of attacks on butterflies by wild individuals of this genus and I shall myself be able to add slightly to these records. Then "Seventeen," my black superintendent, an intelligent native of Inyambane who has been with me for many years, when I asked him the question "Do birds *generally* feed much on butterflies?" replied that he was less sure about the others but that rollers at any rate did—*greatly*. He stated that he had seen instances himself and that it was in any case a matter of common knowledge amongst the natives of his tribe, who acted on the knowledge to the extent of sometimes baiting their roller-traps with butterflies; and he gave me the definite and unusually interesting record that I shall include in a later section of this paper—of a roller that day after day frequented the same dead branch for the purpose of attacking therefrom the butterflies passing to and from some fruit close by. Furthermore, my captive rollers showed, I think, no special repugnance to butterflies as against insects of other orders. It may be objected to this that neither did my captive lemur show any great repugnance to porridge-and-milk—which, nevertheless, constitutes no proof that he had been in the habit of eating porridge-and-milk in the wild state. True, but it *may* constitute an indication that he would possibly have eaten porridge-and-milk in the wild state had he met with it and been able to obtain it; and there can be no reasonable doubt that my rollers *had* thus met with butterflies and were, moreover, probably quite capable of often capturing on the wing even such active insects as the larger *Charaxes* (*vide* my wild bird records). C, the only roller on whom I sufficiently tested the point, displayed what could only, I thought, be interpreted as a very good previous knowledge of his butterflies, while, to reinforce my reply to the lemur argument, I may add that during two separate periods a wild lemur of the same species as my caged one (*Galago crassicaudatus*, Geoff.) formed the habit of nightly visiting our verandahs and stealing from the shelves and tables non-indigenous fruits and the cream from my wife's milk-basins. The first visitations were at a time of year when *Galago*'s natural food was especially abundant, and the whole incident (and others I could quote) seems to me perhaps somewhat to weaken the possible contention that it was only under conditions of captivity that my lemur would have shown no repugnance to such food—or my rollers to butterflies.

On the whole, I feel fairly satisfied that *Coracias garrulus* was a sufficiently suitable species on which to carry out what was, perhaps, my most important series of butterfly experiments.

In view of its relative importance I would like again to emphasize the fact that from the outset I studied the matter of food and spared no pains to provide my captive rollers with a thoroughly varied diet on as natural lines as I could devise. A reference to the list I have already given will show, I think, that I was probably not entirely unsuccessful in this.

2. *The Experiments.* All three of my rollers (A, B, and C) were from the outset remarkably tame and fearless, showing relatively little alarm at passing dogs or servants, and accepting food from the forceps almost at once. They were lethargic birds. B, in particular (the bird on which most of my experiments were carried out), had a very large cage and plenty of perches, but excepting at the northward migration-time (when she sometimes was restless at night) she took very little exercise, remaining as a rule quietly perched in one place, excepting when she descended to eat or drink or shifted her position with the sunlight, of which she was very fond. This was, of course, a pity, and it was quite likely, owing to this lack of exercise, that she relatively seldom, even after a fast, developed so ravenous an appetite as to eat *Acræinæ* readily. She ate heartily, nevertheless, and kept in excellent health and condition throughout.

All three birds expressed their sentiments with regard to the offerings made to them with, usually, a lack of ambiguity that rendered them exceedingly satisfactory subjects for the purpose in hand. All three also appeared to be exceedingly cautious tasters and, though often emphatic enough in their refusals, seldom swallowed an insect, however small or however well-known, without first more or less crushing it (often running it through their bill from side to side as they did so). That is to say, very few insects were eaten without a preliminary tasting, the bird maintaining a highly judicial calmness and precision of demeanour that tended to inspire the onlooker with a certain amount of confidence even while it amused him.

B. Experiments on *Coracias garrulus*. A.

1909. *Feb.* 23. An adult European roller brought me by a woman who had, she said, just limed it. Accepted food from the forceps.

Exp. 1.—*Feb.* 24. Offered the common mud-coloured beetle, with hard elytra, the roller crushed it very slightly with one bite of the point of his bill, and at once swallowed it down, tried and at once rejected a *Neptunides polychrous*, shaking his head after doing so (the same individual had already been rejected by *Centropus burchelli*, A), crushed a few times with the point of his bill, and finally rejected a *Papilio lyæus* with wings, and, on my offering a second without wings, masticated it as before and swallowed it. No sign of dislike was shown, but a second wingless *P. lyœus* was bitten two or three times and rejected. The bird soon afterwards, however, descended and ate it, still neglecting that with wings and the *Neptunides*; both were lying on the floor of the cage. A *Charaxes brutus natalensis* without wings was then well crushed in the bird's bill, but in the end rejected. Half an hour later (I do not know whether the bird had fed in the meantime) I took it out from amongst the other food on the cage-floor and reoffered it. It was again well masticated and thrown back into the throat to be swallowed, but brought out again and rejected, the bird shaking his head afterwards.

[Nothing is said of the state of the bird's appetite. The fact that there was food in the cage throughout does not necessarily in this species prove repletion, but if by any chance Roller A's sentiments towards *Charaxes brutus* (and other large *Charaxes*) resembled that of my other two rollers, then its rejection was practically tantamount to a declaration of nearly complete disinclination for food, whether through repletion or some other cause. In that case the Tenebrionid and the wingless *P. lyœus*, both eaten up to the point of complete disinclination, might fairly be regarded as having been probably found highly acceptable, while the rejection of the *Neptunides* and of the winged *P. lyœus* need not necessarily indicate any very great *un*acceptability for *them*. A preference may perhaps have been indicated in the fact that the *Neptunides* was rejected with promptitude, the *P. lyœus* with wings more waveringly; no preference necessarily attaches to the Tenebrionid, seeing that it was already eaten before the other insects of the experiment were offered. It may, however, be inferred that wingless *P. lyœus* was preferred both to the *Neptunides* and to *P. lyœus* with wings: a good instance of what I have found throughout my experiments—that a butterfly without wings tends to be slightly preferred to the same butterfly with those obstacles still attached.]

Exp. 2.—*Feb.* 25. Tasted with caution and rejected with signs of disgust a larva of *Atella phalantha*.

[Experiment useless, seeing that nothing is stated which might even approximately indicate the state of the bird's appetite.]

Later in the day, noticing that yesterday's *Papilio lyœus* and *Charaxes brutus* were still, with a good deal of other food, lying uneaten in the cage, I offered a ♂ *Papilio lyœus* without wings. It was well crushed and readily eaten. On my now offering a second, however, the bird shook his head and at first took no more notice of it, finally, however, accepting, crushing, and swallowing it. I now offered him a *Precis natalensis* ⊕ f. with the brilliant upper surface of the wings displayed. The bird refused obstinately to have anything to do with it, shaking his head and clapping his bill violently whenever I brought it close up to it. I now offered two butterflies of the same species with all wings removed. Each was crushed at once and swallowed with the greatest apparent relish. On my presenting a yellow ♀ of *Catopsilia florella* with all wings attached, the roller hesitated, then took it in his bill in a half-hearted way, the butterfly at once escaping and fluttering about the cage while the bird settled down and took very little further notice of it.

I extracted and reoffered it, but it was again taken hesitatingly and once more escaped. I then offered a second yellow ♀, this time stripped of wings; the bird ate it readily enough after mastication.

I now offered a *Danaida chrysippus* with wings. The roller's behaviour on seeing it was most striking. He ruffled up the feathers of his crest and mantle, drew himself up and looked most ferocious, shaking his head with the greatest vehemence as I continued to hold the butterfly towards him.

On my offering immediately afterwards an *Acræa acara* ♀ with wings, the bird at first simply ignored the butterfly and later shook his head repeatedly. On my continuing to press it, he indulged in his own equivalent of the owl's "apologetic nibbling" several times, pretending to close his bill lightly over the butterfly and each time drawing back with a shake of the head and a clap of the bill and looking straight at me as though to explain that what I was offering him was not acceptable. A moth (*Xanthospilopteryx superba*), without smell but with wings, was now refused without tasting. On its being reoffered without wings, the bird leant forward, barely closed his bill on it, and at once drew back.

I now turned and offered the moth to *Lanius collurio*, which ate it readily enough. Immediately afterwards the roller accepted, crushed, and readily ate a *Papilio lyæus* and five *Precis natalensis* ⊕ in rapid succession, all without wings.

[Apparently, at the commencement of the experiment, only just hungry enough to eat wingless *P. lyæus*, eaten up to *Charaxes* point on Feb. 24. Wingless *Precis natalensis* ⊕ and wingless *Catopsilia florella* would appear to have been at least as acceptable, in the same state of appetite, as the *Papilio*. I surmised that the roller's behaviour towards the *Precis* with wings perhaps indicated that it reminded him of, e. g., *Acræa acara*. This is exceedingly possible, especially in view of the results of other experiments in which these two butterflies were used, but an alternative possible explanation exists—"wings *versus* no wings,"—which is still more applicable to the bird's treatment of stiff-winged *C. florella*.

I also at the time of the experiment judged the roller's refusal to taste *Danaida chrysippus*, *Acræa acara*, and the *Xanthospilopteryx* to indicate a probable previous acquaintance with those insects. Once more this is exceedingly possible. Alternatively it might be argued that the roller was perhaps so replete as to regard with boredom the eating of any large-winged butterfly with the wings attached. Nevertheless, the special refusal of the *Danaida*, with every sign that in my subsequent long series of experiments on birds of the same species I came to associate with the very greatest unacceptability, should be given full weight.

Usually acceptable butterflies of distinctive appearance should have been offered *with wings* after the refusal of the *Danaida*, etc.

The *Catopsilia* refused earlier is useless to us, seeing that yellow ♀ *C. florella* with wings has frequently been an object of suspicion in the course of my experiments, even when the birds were quite hungry enough to be in nowise deterred by wings pure and simple.

At the end of the experiment a preference was shown for wingless *P. lyæus* and *Precis natalensis* as against wingless *Xanthospilopteryx superba*. The fact that no less than five of the *Precis* were eaten in addition to the *Papilio* shows that, actually, the roller had *not* been quite replete.]

Exp. 3.—*Feb.* 27. Bird very restless to-day, off his feed, and spending all his time in trying to get out. On my offering him by forceps larval migratory locusts and the larvæ of, probably, *Rhabdotis aulica*, he often simply crushed them slightly and tossed them away, treating similarly wingless *Atella phalantha*, *Charaxes zoolina*, and *Charaxes brutus natalensis*. Later I gave him a wingless *Papilio lyæus*. He crushed and dropped it the first time, but again crushed it on being reoffered, and this time swallowed it. A second, however, after being for some time refused without tasting, was crushed and tossed away, then on being reoffered crushed and swallowed it. Two *Precis natalensis* ⊕, both without wings, were crushed and swallowed without hesitation.

[Any experiment on a bird in this mood was likely to be simply wasted, but the roller's apparent preference (deducible, perhaps, from the difference in manner) for *P. natalensis* ⊕ as against *P. lyæus* may possibly be worth noting for comparison with future and surer results.]

Exp. 4.—*Feb.* 28. Plenty of food in the cage, but the bird was still rather chafing at confinement and it was not easy to secure his attention continuously. Thus an average interval of three or four minutes elapsed between his acceptances down to the *Precis ceryne*, inclusive. The last three trials were in quick succession.

The abdomen of a ♀ *Hypolimnas misippus*, rejected by *Lanius collaris*, was well crushed and swallowed without hesitation, as were also a *Precis artaxia*, six *Precis natalensis* ⊕, and two *Precis ceryne*. The bird now crushed slightly in the point of his bill and tossed away an *Atella phalantha*, crushed and readily ate a *Precis natalensis* ⊕, and once more rejected the *Atella phalantha*. All the butterflies in this experiment were offered without wings.

[*Precis natalensis* ⊕ was apparently very distinctly preferred to *Atella phalantha*, but the mood of the bird enjoins caution in drawing any conclusions from this experiment.]

Exp. 5.—*Mar.* 3. The roller, placid now and eating well, readily accepted and ate three *Papilio lyæus*, refused a fourth, then after an interval ate four more.

[An instance probably of the effect of subsidence resulting from digestion, the bird being thus enabled to return to an insect that shortly before had become unacceptable: *cf.* other experiments, *passim*.

Seeing that only one species of insect was offered and that no good indication is given of the state of the bird's appetite, nothing can be deduced from this experiment of the pleasantness or otherwise of *P. lyæus*.]

Conclusions from Experiments on Coracias garrulus, A:—The conclusions have been stated at the end of each experiment, and strike me as neither sufficiently numerous nor sufficiently secure to be worth summarizing here. No attempt seems to have been made at any time to ascertain the exact state of the bird's appetite, and on two days he was experimented on when, owing to his unsuitable mood, he should have been left alone. It must be remembered, however, that these experiments were intended not as preference experiments but to accustom the bird to the various species of butterflies, his preferences in which I hoped to ascertain later. That the experiments proceeded no further was due to his premature escape.

C. CORACIAS GARRULUS. B. EARLY EXPERIMENTS.

1909. *Mar.* 7. Another adult European roller was limed and brought to me this afternoon.

[There is very little to be deduced from the following fifteen experiments—to May 18,—though they mostly afford illustrations of the phenomenon commented on for Roller A on March 3. In any case, neither they nor those on A were intended as preference experiments. These may perhaps be regarded as commencing, for this bird, on May 20. Those of April 1, 9, and 15 were "mimicry" experiments.

In connection with those experiments that commence with "Plenty of food uneaten in cage," I may remark that I had probably at that period still to realize that this roller (unlike some of my other birds) frequently allowed herself to get moderately empty before going down again to feed, and that abundance of uneaten food, however pleasant, did not therefore necessarily indicate approximate repletion.]

Exp. 6.—*Mar.* 9. Crushed and swallowed a wingless *Papilio lyæus*, refused the next, but accepted it three minutes later, and in this way ate seven in all with a refusal and about a three minutes' interval between each. [She was evidently throughout barely hungry enough for them, a few minutes' digestion after each refusal rendering her just hungry enough for another acceptance.]

Exp. 7.—*Mar.* 10. Crushed well, and, though she had not appeared to be hungry, ate with apparent relish a *Charaxes zoolina*, a *Charaxes guderiana*, and two *Charaxes candiope*, accepted with evident distinction a *Charaxes brutus natalensis*, crushed it slightly and dropped it. On my reoffering it ten minutes later she ate it readily, as also a second and a *Charaxes neanthes*.

[In concluding my account of this experiment I stated that I was left with the impression that the *Charaxes* were more enjoyed than the Papilios of the day before. I must confess, however, that there is nothing in the two experiments *as recorded* that necessarily indicates this, seeing that in neither case was the state of appetite definitely noted.]

Exp. 8.—*Mar.* 23. Had plenty of food in the cage and did not appear in the least hungry, but readily ate, after crushing each, five *Hypolimnas misippus* in rapid succession (a ♂ and four ♀). I now left five or eight minutes to allow for after-effects and offered two more ♀ ♀, both of which were readily accepted and eaten. Each butterfly in this experiment had one hindwing attached to ensure recognition by the bird.

[The same applies to all the following experiments, unless otherwise stated. The short interval for after-effects was a habit of mine at that time, plausible enough but usually perfectly futile, for it merely gave the bird time to become just hungry enough for more of the same species.]

Exp. 9.—*Mar.* 24. In this experiment, which is certainly not worth quoting in detail, seven *Papilio lyœus* and five *P. demodocus* were eaten at intervals, refusals intervening. Some of the intervals were long, as the result, apparently, of great restlessness on the part of the roller, which kept moving about the cage. I regard the experiment as completely unreliable.

Exp. 10.—*Mar.* 26. Ate most readily a *Catopsilia florella* (just rejected by *Lobivanellus lateralis*), a *Papilio lyœus* ♂ (just refused by *Irrisor erythrorhynchus*), and five *Papilio demodocus* in quick succession. The sixth, however, was thrown away and the bird at once descended and ate a migratory locust or two. It later again refused the sixth *P. demodocus*, this time without tasting.

[It seems likely that it preferred the locusts to *P. demodocus*, but there is nothing to indicate the estimation in which it held the *Catopsilia* and the *P. lyœus* relatively either to each other, to *P. demodocus*, or the migratory locusts—nor to show how near to, or far from, actual repletion the bird still was when the latter were eaten.]

Exp. 11.—*Mar.* 30. The bird readily accepted from the forceps seven wingless *Charaxes candiope* in rapid succession, crushing each well before swallowing it. She was evidently, from her manner, becoming replete towards the end, and a wingless *Charaxes brutus* which I now offered was merely played with, being for quite a long time continually tossed up into the air and caught again as it descended. Finally, it was dropped. I reoffered it ten minutes later when it was eaten readily, as also a second and a third. The next was accepted and then listlessly dropped, but readily eaten on being reoffered a few minutes later, as was also a fifth. I now offered two more, also a *Charaxes candiope*, but the roller could not be persuaded to eat them. I accordingly left all three in the cage and on returning shortly afterwards found that the *candiope* had been eaten. In the evening, six hours later, one *brutus* was still left, but there had been quantities of other and varied food in the cage all the time, so that it may quite likely have been overlooked. Certainly the bird seemed to enjoy both species of *Charaxes*.

[I was probably correct in supposing the bird to be replete. Real repletion on the part of the roller was usually easy to recognize, and the playing with the prey, recorded above, was only indulged in at that stage. The eating of *C. candiope* and *C. brutus* right up to this point certainly seems to indicate that they were much liked—probably what we may call "Grade 1" insects. Subsequent refusals may well have been the result of sheer repletion, and there was nothing apparently to indicate that the *C. brutus* left in the cage was noticed by the bird.]

Exp. 12.—*Apr.* 1. A MIMICRY EXPERIMENT.—Tasted and at once rejected *Acrœa areca* ♂, afterwards refusing decidedly and persistently to have anything to do with *Pseudacrœa trimeni* ♀, *Acrœa areca* ♀, and, once more, the *Pseudacrœa trimeni*. On being shown an *Acrœa acara*, however, it leant forward and cautiously tasted it, promptly rejecting it. She then refused, without tasting, *Precis natalensis* ⊕ f. and *Pseudacræa trimeni*, but accepted and ate a *Catopsilia florella* with the greatest readiness. All the butterflies in this experiment were offered with all wings attached and upper surface fully displayed.

[The bird certainly appeared to differentiate between the *Acræa acara* and the *Pseudacræa*, though less sure, apparently, of the latter and *Acræa areca.* It is possible that *Precis natalensis* escaped through its rough general likeness to *Acræa acara.* The two Acræas were evidently definitely disliked—at any rate, relatively to the only butterfly eaten, *C. florella.* In this case no complication arises in connection with the presence or absence of wings (as happened in the similar experiment on Roller A). *C. florella,* the stiffest-winged of all, was swallowed, with its wings, at the very end of the experiment.]

Exp. 13.—*Apr.* 4. Plenty of other food in cage. Ate with the greatest readiness and no sign of dislike three *Papilio dardanus* ♀ f. *hippocoon*, each with one hindwing attached.

[As the roller's state of appetite was not definitely indicated, nothing useful can be deduced from this experiment.]

Exp. 14.—*Apr.* 5. Independent Experiment by my Wife.—Each butterfly, as usual, had one hindwing attached. The bird ate readily six *Precis cebrene* in rapid succession. My wife now waited five minutes for possible after-taste or after-effects to make themselves felt, and offered a seventh. It was recognized with evident pleasure and swallowed with as much apparent relish as its predecessors. The bird now ate in rapid succession six *Precis clelia*, showing actual and increasing eagerness and craning out for each butterfly as it appeared near the bars. After the usual short interval a seventh was offered. The bird, evidently recognizing it, reached out, snatched it from the forceps, and ate it with evident pleasure. She now readily accepted and ate two *Antanartia schœneia*, seven *Belenois*, and three *Salamis anacardii*, all in rapid succession.

The third *Salamis* was accidentally dropped from the forceps and the bird appeared quite concerned, leaning well over and gazing down at it. It was quickly picked up and reoffered, and this time eaten rapidly. A fourth *Salamis*, dead this time but not appreciably dry, was now offered, but the bird dropped it two or three times, each time after crushing it. She ate it, however, readily on its being reoffered fifteen minutes later. After this she readily ate two *Eurytela hiarbas*.

[The bird was probably fairly hungry at the commencement, but, seeing that there was no rejection early in the experiment by which one might have gauged her state of appetite, all that can be deduced is that, when hungry enough to do so, the roller would eat with every sign of relish the butterflies mentioned, including *Belenois* and *Precis*, in considerable numbers. There was nothing to indicate what grade any of the butterflies fall into, or how they stand relatively to one another.]

Exp. 15.—*Apr.* 9. A Mimicry Experiment.—The roller tasted and promptly flung away *Amauris ochlea* and refused it without tasting on its being reoffered.

I now continued to offer it, four times in all, at short intervals, but the bird refused to have anything to do with it—in fact, simply ignored it. On the fifth occasion I offered *Hypolimnas wahlbergi* instead. The bird appeared at once to recognize that there was a difference, and, as in the case of the *A. acara* of the other day, leant forward to take it. At the last moment, however, she thought better of it and withdrew, without having actually touched it, and, though I continued to hold it to her, would take no further notice of it. *Papilio dardanus* ♀ f. *hippocoon* was now offered, but simply ignored.

In each case I had first fully displayed the colours of the butterfly just outside the bars before actually offering it. I had then held it through the bars by two wings, in the forceps, just in front of the bird, so as to allow it to flap.

She now ate with the greatest readiness six *Pyrameis cardui*, each with one wing attached, and, after the usual probably futile five minutes' interval for possible after-effects, a seventh; then accepted, crushed well, and ate with apparent relish the *Hypolimnas wahlbergi* with all wings removed, and after it the *Papilio dardanus* ♀ f. *hippocoon* similarly stripped.

Probably both these butterflies, as also *P. cardui*, were preferred to the *Amauris.*

[I apparently felt little doubt at the time that the bird at once detected the difference between *Amauris ochlea* and *Hypolimnas wahlbergi.* That she should have hesitated, nevertheless, to attack the latter might indicate (1) that so far as she was concerned *Amauris ochlea* is to some extent capable, even at a close view, of acting as protector of the mimics of *A. dominicanus*, (2) that the bird had already met with *A. dominicanus* and remembered it in time to refrain from attacking the *Hypolimnas* (and *Papilio*), (3) a general suspicion of large black and white butterflies, or (4) repletion to the point of not caring to swallow such large-winged insects. She has not usually hesitated to swallow even large species of *Charaxes*, wings and all, up to practically repletion-point, so that this fourth explanation does not seem likely to be the correct one, especially as she went on to eat with readiness and relish six *Pyrameis* with one wing and a *H. wahlbergi* and *Papilio* with none.]

Exp. 16.—*Apr.* 10. Had not long before retired to her perch after feeding on migratory locusts, etc. She, nevertheless, accepted and ate with apparent readiness and in quick succession, each after crushing it, a *Neptis agatha*, a ♂ *Hypolimnas misippus*, two *Belenois mesentina*, three *Belenois severina*, a *Mycalesis campina*, a *Precis natalensis* ⊙, and a ♂ *Leuceronia thalassina.*

[This is quite a good instance of the fact that one should never assume a bird to be replete, or nearly so, unless one has actually fed it up to repletion by hand.

Several of the above butterflies have since proved to be acceptable to her by no means up to repletion-point.]

Exp. 17.—*Apr.* 15. A MIMICRY EXPERIMENT.—*Coracias garrulus* persistently refused *Acræa acara* without tasting and with emphatic shakes of the head. On my now offering *Pseudacræa trimeni*, a specimen that, except in size, was distinctly more like *acara* than *areca*, the bird at once leaned forward to take it, but suddenly (as on previous occasions) thinking better of it, withdrew and thenceforth simply ignored it. She then refused ♀ *Acræa areca* with a sharp shake of the head.

[This *Pseudacræa* was, I noted, distinctly more like *Acræa acara* than that used in experiment 12, having a whitish area on the upper surface of each hindwing and a particularly strongly-marked subapical fulvous patch to the forewing. The bird, nevertheless, had seemed to discriminate between it and a very similarly-coloured specimen of *Acræa acara*, possibly partly as a result of the difference in size. She may, of course, have distinguished it equally from *Acræa areca* ♀. At any rate, its general likeness to one or both Acræas was probably sufficient to deter the bird, on second thoughts, from tasting it.

The last time the roller had seen either of these Acræas or any other butterfly with at all similar coloration was exactly fifteen days before, and before that again she had seen nothing at all resembling them for at least twenty-five days—that is to say, since March 7, the day on which she was captured. On April 1 she had tasted and rejected each, apparently distinguishing one from the other so far as appearance was concerned.

It is a pity that the roller's state of appetite was not ascertained here, as without that the suspicion must necessarily remain that she may have refused the insects through sheer repletion.]

Exp. 18.—*Apr.* 28. *Coracias garrulus* ate readily four *Pyrameis cardui* and refused the next, but five minutes later accepted equally readily and ate with evident relish two more and refused a third, and, five minutes later, again five more and again refused. All had wings.

[The refusals were probably due to the bird's having reached the repletion-stage for *Pyrameis.* Whether this was actual, absolute repletion-stage or not is unfortunately not indicated by the experiment as recorded.]

Exp. 19.—*May* 12. Crushed well and readily swallowed a *Belenois mesentina* (an individual already tasted and rejected by *Phyllostrophus flavistriatus* and *Emberiza orientalis* and refused without tasting by *Lanius lateralis*). No sign of dislike was shown, but a ♂ *Mylothris agathina* with decided sweet-brier smell had barely been tasted when it was emphatically flung away.

[It seems not unlikely that the *Mylothris* was found distinctly more unpleasant than the *Belenois*, though this conclusion must be regarded as based purely on the great contrast in manner. It would have been a safer conclusion had the *Belenois* been eaten after the *Mylothris* refusal.]

The conclusions to the first thirteen preference experiments on *C. garrulus*, B, were worked out at a date when I had not begun fully to appreciate the influence of "the preceding offering." This will have made so little difference, however, that, being pressed for time, I have not thought it worth while to recast them. Perhaps even the otherwise rather unnecessary detail in which they are stated is useful in emphasizing the vast difference between a low-grade insect and one that is eaten to repletion-point. Contrast, for example, *Melanitis leda* and *Mylothris yulei* in experiment 27.

D. *CORACIAS GARRULUS*. B. PREFERENCE EXPERIMENTS.

Exp. 20.—*May* 18. The bird appeared somewhat hungry. She eagerly ate a *Charaxes candiope*, a *Charaxes cithæron*, and a *Charaxes achæmenes*, then twice rejected, each time after tasting, a *Nychitona medusa* ♀, but readily ate another *Charaxes cithæron*.

[There seems little doubt that the *Nychitona*, for whatever reason, was liked distinctly less than the last *Charaxes*, and at any rate not better than *C. achæmenes*.]

Exp. 21.—*May* 20. I fed the bird to repletion by hand at the commencement of this experiment. She ate readily immediately after a large number of various grasshoppers etc., six *Charaxes brutus natalensis*, mostly with one wing attached, but refused a seventh, quite evidently through repletion.

Ten minutes later I again offered the seventh *Charaxes* with one wing attached. It was at once recognized and accepted with the greatest readiness, then well crushed and eaten. *Precis cebrene* and *Neptis goochi* (each with one wing) were, however, refused without tasting, the bird being probably in any case once more replete.

A few minutes later again she readily ate after the usual tasting a *Precis cebrene* without wings, tasted and rejected two wingless *Neptis goochi* in succession (they had already been tried and rejected by the Kingfisher), but for some time absolutely refused to touch a *Nychitona medusa* with one wing, of which she possibly retained unpleasant memories from two days before. Finally, however, she leant forward, tasted it with the greatest caution, and at once withdrew without removing it from the forceps. She now tasted and at once crushed and swallowed a *Precis cebrene* without wings, tasted and readily ate a *Melanitis leda*, tasted carefully and rejected a wingless *Belenois mesentina*. On my now offering a wingless *Papilio echerioides* ♂ the bird leant forward to take it, but struck short (accidentally), merely snapping off one of its antennæ. This she at once threw away with evident dislike, shaking her head repeatedly as I continued to hold the butterfly to her and refusing persistently to have anything more to do with it.

[I judged (no doubt, as usual, from the bird's growing difficulty in getting the insects down) that the *Charaxes* were eaten up to or very nearly up to actual repletion-point. Assuming, for convenience, that the former was actually the case, I will provisionally place *Charaxes brutus* in what I will call Grade 1. It seems likely from the refusal of *Precis cebrene* and *Neptis goochi* immediately afterwards that they at any rate did not come higher than this Grade 1, and from the eating of the *Precis* only a few minutes later that *it* did not come appreciably below it. With *Melanitis leda* (stimulation?) it was then eaten readily immediately after the rejection of *Neptis goochi* and *Nychitona medusa*. This gives the order :—

1. *Charaxes brutus*, *Precis cebrene*, and, perhaps, *Melanitis leda*.
2. *Neptis goochi*, *Nychitona medusa*.

The *Belenois* and *Papilio* were at any rate probably not preferred to the *Precis* and the *Melanitis*.]

Exp. 22.—*May* 21. Ate readily in succession five *Charaxes cithæron* and six *Charaxes candiope*, refusing a seventh (probably replete). Some of these had a wing, some were wingless. Five minutes later she accepted and ate the seventh *candiope* with apparent enjoyment, refused *Neptis saclava* without tasting, tasted and rejected *Neptis agatha*, crushed and very readily ate *Precis archesia*, tasted and rejected a *Papilio dardanus* ♂ with the usual smell somewhat strongly developed, and refused without tasting *Salamis anacardii* and *Papilio dardanus* ♀ f. *hippocoon*. All these were wingless.

Twenty minutes later I offered a wingless *Eurytela dryope*. This was at first refused without tasting, but the roller, which had possibly at first still had *Neptis* in mind, changed the latter and, having tasted the butterfly, crushed and swallowed it. Wingless *Neptis saclava* was then also tasted but rejected, while a ♂ *Catopsilia florella*, wingless, and two freshly dead (and supple) *Atella phalantha* with one wing each were well tasted and eaten, as also a *Eurytela hiarbas* (no wings) and a wingless ♂ *Leuceronia thalassina*. A wingless *Neptis agatha* was now tried, but the bird only got one antenna in its mouth as in the case of *Papilio echerioides* yesterday and then drew back in apparent suspicion and refused it, but a *Pyrameis*, with one wing, was tasted and eaten most readily. The bird now tasted and rejected a wingless *Terias senegalensis* and twice crushed and rejected with evident dislike a *Mycalesis campina* with one wing, afterwards refusing persistently to touch a *Belenois mesentina*, again with one hindwing attached. She readily, however, accepted and ate a *Pyrameis cardui*, a *Charaxes*, a *Precis cebrene*, two *Precis ceryne*, a *Melanitis leda*, and another *Pyrameis*, refusing the next *Pyrameis*, probably owing to repletion. Except the *Charaxes*, which was wingless, each of these last seven insects had one wing attached.

[Assuming, what at the time seemed likely, that *Charaxes candiope* was eaten to near repletion-point, *P. archesis* ⊙ f. is also likely to have been eaten fairly near that point. *P. dardanus* ♂ was at any rate probably not liked *better* than these two. The 20-minutes' interval renders the placings of the later insects relatively to *C. candiope* more uncertain, but the following preferences seem deducible from the experiment as a whole:—

P. archesia preferred to *N. agatha* and *N. saclava*, *E. dryope* and *C. candiope*, at any rate not appreciably worse than the latter.

C. florella and perhaps *A. phalantha*, *E. hiarbas*, and *L. thalassina* preferred to *N. saclava*, and the *Leuceronia* at any rate was probably not liked less than *N. agatha*.

P. cardui, and perhaps *Charaxes*, *P. cebrene*, *P. ceryne*, *M. leda* each preferred to *T. senegalensis*, *M. campina*, *B. mesentina*, *N. saclava*, and *N. agatha*, and, if the *Pyrameis* was finally refused through repletion, probably in or near Grade 1.

P. dardanus ♂ was probably at any rate not preferred to *P. archesia*; *N. agatha* and *N. saclava* to *C. candiope*; *N. saclava* to *E. dryope*; or *N. agatha* to *L. thalassina*.

The bird's recognition and refusal of *Belenois* may be just worth commenting on. It will be remembered that the last—and that a single—example of this genus with wing attached that the bird had seen was on May 12, nine days before (readily eaten), and that previously to that she had seen none since April 10, when she readily ate five, although five days before that again she had with the greatest readiness eaten seven in rapid succession and had doubtless then "sized it up" even if she had never met it before. She must then from April 10, with a small reminder on May 12, have retained in her mind a sufficiently clear impression of the degree of unpleasantness possessed by *Belenois*, ready to be put to use on the first occasion on which she was sufficiently replete to do without that butterfly.]

Exp. 23.—*May* 22. The bird was fed on grasshoppers till she refused to take any more. She, nevertheless, then accepted and ate, though with apparent difficulty as the result of growing repletion, four *Charaxes cithæron*, wingless, refusing the next without tasting. Ten minutes later she accepted and ate, though with obvious lack of appetite, two more *Charaxes cithæron*, refusing the next.

Five minutes later she again refused it.

Five minutes later again (*i. e.* ten minutes after probable repletion) she crushed and readily ate *Charaxes achæmenes*, refused without tasting *Precis cebrene* and *Atella phalantha* (each with one wing), took but threw away a wingless *Precis natalensis* ⊙ f. She tested it well, however, and swallowed it without apparent dislike on its being reoffered. The next was refused without tasting, but a ♀ *Charaxes ethalion* was accepted and eaten. The bird then again tried and tossed aside the *Precis natalensis* ⊙ f., but swallowed readily, after similarly crushing it, *Charaxes candiope*. She then refused the *Precis natalensis* without tasting, tasted and rejected a ♂ *Leuceronia thalassina* and a *Terias*, refused a wingless *Atella* without tasting, quite likely however recognizing it from its fulvous coloration, also, once more, the *Precis natalensis* ⊙ f. (throughout offered without wings). A wingless *Melanitis* was, however, crushed and readily eaten, as was also a *Precis cebrene*. *Charaxes neanthes* with one wing was then crushed slightly and thrown aside, *Pinacopteryx pigea*, wingless, was refused persistently without tasting, *Precis natalensis* ⊙ f. was refused and then accepted and dropped, but three *Melanitis* in succession were crushed and readily eaten, as were *Papilio dardanus* ♀ f. *hippocoon* (without perceptible smell), *Hamanumida dædalus*, and *Precis ceryne*. A second *Precis ceryne* was refused without tasting. I have never yet seen the roller so obviously replete.

All butterflies in this experiment were offered with one hindwing attached, unless otherwise stated.

[Conclusions: *C. cithæron*, judging from signs of repletion, was placed as high, probably, as any butterfly yet. *C. achæmenes* is probably in Grade 1 too, or at any rate no lower than *P. cebrene*; the *Charaxes ethalion* ♀ and *C. candiope* were preferred to *P. natalensis* ⊙ f., an individual of which, however, was eaten at, or not far from, repletion-point; *M. leda* and perhaps *P. ceryne*, *P. cebrene*, *H. dædalus*, and *P. dardanus* ♀ f. *hippocoon* were also all apparently preferred to a *P. natalensis* ⊙ f. as well as to *L. thalassina* ♂, *Terias*, and, probably, *Atella phalantha*. The *Melanitis* and perhaps the *Papilio*, the *Hamanumida*, and *P. ceryne* were also preferred to *P. pigea* and *Ch. neanthes*, *or else to whatever these two butterflies may have been reminiscent of*, and *P. cebrene* was at least not liked worse than these latter.]

Exp. 24.—*May* 23. Crushed and unhesitatingly rejected the larva of *Pyrameis* *cardui.* This was early in the morning, before the bird had been supplied with food, and she was unmistakably hungry and eager.

[At this time of day, before feeding, the bird, as will be seen later, was sometimes hungry enough to eat even *Acræinæ*, so that the unacceptability to her of the *Pyrameis* larva is likely to have been very considerable.]

Later in the day (the bird had just previously been feeding on grasshoppers) she tasted and rejected *Neptis saclava*, refused without tasting *Phrissura isokani* (quite likely taken for *Mylothris*), readily ate, after crushing each, *Precis clelia*, *Pyrameis cardui*, *Precis cebrene*, a *Mycalesis safitza* (with all its wings), and a *Precis archesia* ⊙ f., but rejected, after tasting it, a *Belenois mesentina*.

Three *Charaxes brutus*, two *Charaxes candiope*, and a fourth *Charaxes brutus* were now readily eaten, the last two with difficulty; the next was crushed and dropped, and on being reoffered refused without tasting. Bird apparently thoroughly replete. She now crushed slightly and threw away *Catopsilia florella* ♂, refused without tasting *Pyrameis cardui* and *Precis cebrene*, but then accepted, crushed well, and swallowed *Charaxes guderiana*, afterwards crushing and dropping *Charaxes neanthes* and refusing without tasting *Charaxes cithæron*.

Fifteen minutes later she readily accepted and ate a *Precis cebrene* and a *Catopsilia florella*, but refused without tasting a *Pyrameis*, a *Mycalesis safitza*, a *Leuceronia*, and a *Charaxes neanthes*, evidently still feeling replete.

Five minutes later she ignored *Precis cebrene* and a *Pyrameis cardui*, but accepted and swallowed, though with decided disinclination, *Catopsilia florella* and *Charaxes cithæron*, refusing the next *C. cithæron*.

I afterwards at intervals (during 20 minutes) offered her *Charaxes* and other butterflies and grasshoppers, but she was apparently thoroughly gorged and completely ignored them all as she basked in the sun with feathers ruffled out and bill open—a common habit.

[Apparent order of preference :—

a. *P. clelia* and perhaps *M. safitza* and *P. archesia* ⊙ f. { 1. *C. guderiana.*
    2. *C. brutus* and perhaps *C. candiope*, *P. cebrene*, and *P. cardui.*
    3. *N. saclava* and *P. isokani* (or whatever the latter was taken for); *B. mesentina.*

b. 1. *C. guderiana,* } perhaps *C. cithæron.*
    2. *C. florella,* }
    3. *P. cardui*, *P. cebrene*, *C. neanthes*, *M. safitza*, *Leuceronia.*]

The *Pyrameis cardui* larva was probably much disliked.

Exp. 25.—Seeing that the bird was unlikely to eat more before his next pellet, I now left scattered fairly closely and thoroughly mixed on the floor of its cage three *Charaxes brutus*, three *Charaxes candiope*, three *Pyrameis cardui*, three *Precis cebrene*, one *Eurytela hiarbas*, three *Neptis saclava*, and one *Papilio lyæus*. From her experience since entering confinement the bird should have known well all these butterflies except perhaps *Eurytela*, which she had had only once. I hoped in this way to gain some confirmation by another method of her already displayed preferences.

Half an hour later two *Charaxes candiope* only had been eaten.

Half an hour later again two *Charaxes brutus* only had been eaten.

I next put in a handful of grasshoppers, etc., in great variety and two more *Charaxes brutus.* The bird descended, ate a number of the grasshoppers, and returned to her perch, having taken no notice of the butterflies.

Three hours later (evening) there remained one *Charaxes brutus*, one *Pyrameis cardui*, one *Junonia*, one *Papilio lyœus*, a number of the bird's favourite species of grasshoppers and some termites. The butterflies eaten since I last looked were two *Charaxes brutus* (two of the five had been eaten previously), one *Charaxes candiope* (two of the three had been eaten at the outset), two out of three *Pyrameis cardui*, two out of three *Precis cebrene*, the only *Eurytela hiarbas*, and all three *Neptis saclava.*

[The first butterflies eaten were four out of six large *Charaxes*, the smaller butterflies amongst which they were scattered having been apparently ignored. This might seem to merely confirm my other experiments which have always seemed to place these two species of *Charaxes* in Grade 1. Actually, however, an exceedingly important factor in determining the bird's choice is likely to have been *size.*

Against this we find that two out of nine big butterflies were left at the end, and also only two out of ten small ones. But it is possible that through stillness or position the two large butterflies left escaped the roller's observation, while some of the smaller ones were more prominent or accessible or happened to move.

Then as to relative pleasantness. Three butterflies out of fourteen that the other mode of experimentation places in or near Grade 1 were left uneaten and only one (and that the pleasantest) of the five that it places below Grade 1 : 21 °/₀ against 20 °/₀. These figures again would appear to indicate indiscriminateness—and "indiscriminateness" there may have been if the roller, on the occasion of any of her unwitnessed descents, had been hungry enough to eat *Neptis saclava*, the lowest-grade butterfly put down : and she obviously *had* been hungry enough. Under these circumstances *Neptis saclava* would be in a sense as acceptable to the roller as a *Precis* or *Pyrameis*, and would certainly be picked up and eaten if it caught her attention first or were more accessible.

The one definite preference apparently shown (apart from that for *Charaxes* at the commencement) was for the pleasanter grasshoppers as against *any* of the butterflies. Yet even this conclusion is not secure. Was the handful of insects put down together in a prominent mass, or was it scattered evenly through the butterflies already there? Would the roller at that moment not perhaps have descended with equal readiness and eaten as heartily had the handful been one of high-grade butterflies? Was she temporarily tired of butterflies and wanting a change through having eaten so many? Or, did she actually and usually (as was very possible) prefer the grasshoppers to the pleasantest butterflies?

The experiment, a poor one, unfortunately answers neither these questions nor any other. It was mostly unwatched, and such portions as *were* witnessed were not sufficiently fully recorded.]

Exp. 26.—*May* 24. Had evidently not gone down to eat recently as she was unmistakably hungry in manner. She crushed and readily ate a *Neptis agatha*, but threw away a *Neptis saclava.* She went on to crush and eat in quick succession another *Neptis agatha*, a *Neptis saclava*, and a *Neptis goochi*, then seven more *Neptis saclava*, four *Neptis goochi*, and yet another *Neptis agatha*, also a *Belenois* and a *Leuceronia argia* ♀. All these were eaten with apparently the greatest relish. She then tasted and rejected with evident dislike *Mylothris agathina*, *Nyctemera leuconoë*, and *Danaida chrysippus*, but readily ate a *Pyrameis cardui*, a *Precis clelia*, and a *Precis cebrene.* All the above had one hindwing attached.

I now gave her five *Charaxes brutus*, all of which were eaten with apparent relish. She then tasted and rejected *Neptis agatha* with evident dislike and refused without tasting *Neptis saclava*, each of these with one wing, afterwards tasting and rejecting, without wings, *Neptis saclava* and *Eurytela hiarbas.* She then refused *Precis cebrene*, wingless, but immediately afterwards tasted it and, evidently reassured, swallowed it at once with the greatest readiness, as also a *Pyrameis cardui.* She now tasted and rejected a one-winged *Eurytela hiarbas*, tasted suspiciously and, after a little wavering, dropped *Catopsilia florella*, but readily ate, after crushing it, a *Charaxes neanthes*, refused persistently even to taste *Terias senegalensis*, *Glutophrissa saba* ♀, and *Belenois severina*, each with one wing, hesitated considerably over taking a *Charaxes zoolina*, very possibly, I think, as a result of its whitish coloration, and finally tasted it very warily and with evident suspicion and dropped it. On my reoffering it a second and third time, she each time again went through this performance, apparently not finding enough wrong with the taste to decide her finally against the insect, yet perhaps unable to make up her mind to eat a butterfly which in appearance possibly reminded her of some Pierine that she was not hungry enough to eat.

She now readily ate a *Charaxes cithæron*, two *Charaxes candiope*, and three *Charaxes brutus*, the last two or three with decided difficulty, evidently through repletion, refused without tasting *Pyrameis cardui* and *Precis cebrene*, crushed perfunctorily and threw aside a *Precis archesia* (wingless), refused without tasting a wingless *Charaxes zoolina*, crushed and listlessly threw aside *Charaxes neanthes*, and refused without tasting *Pseudacræa lucretia.*

Now and during the next forty minutes I several times offered her the pleasanter grasshoppers and such butterflies as the large species of *Charaxes*, *Pyrameis*, and *Junonia*, but they were always refused without tasting. At about the end of that time, however, she roused herself somewhat, tasted and readily ate two *Precis cebrene* and a *Precis clelia*, tasted and rejected *Neptis saclava* and *Glutophrissa saba* ♀, but readily ate after tasting each a *Precis cebrene*, a *Pyrameis cardui*, the *Charaxes neanthes* previously refused, and *Precis archesia*, tasted and rejected *Papilio angolanus* and *Pseudacræa lucretia*, but readily ate a *Pyrameis cardui.* She then tasted and rejected a *Byblia*, readily ate a *Precis cebrene*, tasted and rejected *Acræa encedon*, but readily ate a *Pyrameis cardui* and a *Precis cebrene.*

A little later, evidently slightly hungrier, she ate readily enough, after crushing each, a *Eurytela hiarbas* and a *Neptis saclava*, then (but with some slight hesitation) a *Neptis goochi.*

[In the first part of the experiment the roller ate *Pyrameis cardui* (2), *Precis cebrene* (2), *Precis clelia*, *Charaxes brutus* (8), *C. neanthes*, *C. cithæron*, and *C. candiope* (2) after refusing to eat *Mylothris agathina*, *Nyctemera leuconoë*, and *Danaida* *chrysippus*; ate all the first *P. cardui*, *P. cebrene*, *C. brutus* (3), *C. neanthes*, *C. cithæron*, and *C. candiope* (2) after refusing *Neptis saclava*, *Neptis agatha*, and *Eurytela hiarbas*; *C. brutus* (3), *C. neanthes*, *C. cithæron* (1), and *C. candiope* (2) after refusing, waveringly, *C. florella*; and the three largest *Charaxes* (1 *cithæron*, 2 *candiope*, and 3 *brutus*) after refusing *Terias senegalensis*, *Glutophrissa saba*, *Belenois severina*, and, possibly from suspicion of its white coloration, *Charaxes zoolina*.

From the wavering nature of the *Catopsilia*'s rejection it seemed not unlikely that it too would have been eaten nearer repletion than either species of *Neptis*, the *Eurytela*, the *Mylothris*, the *Nyctemera*, or the *Danaida*. The fact that the last three species were refused no less than 17 places away from repletion (11 of these places being occupied by such bulky insects as *Charaxes brutus*, *cithæron*, and *candiope*) would seem to indicate that the roller placed them very fairly low. The great contrast in manner might be taken to suggest that *Neptis agatha*, the *Leuceronia*, and the earlier *Belenois* would have been placed higher than they, but all, I think, that can be said with any safety is that the *Leuceronia* at all events was not placed lower than the *Mylothris*, etc. It and its companions should have been reoffered after the latter's rejection.

N. agatha, *N. saclava*, and *E. hiarbas* were rejected at 9 places from repletion (the 9 including 6 large *Charaxes*), the *Catopsilia* at 7 (quite unusually low for it). The *C. neanthes* was at any rate not below the later *Belenois*, the *G. saba*, and the *Terias senegalensis*, and these three insects were refused at 6 places from repletion. The 3 large species of *Charaxes* were at any rate not below *P. cardui*, *P. cebrene*, *P. archesia*, *C. neanthes*, or any species of grasshopper that I was able to offer. The latter point is interesting in relation to experiment 25.

Last part of experiment: *P. cardui* and *P. cebrene* above the *Byblia*, *A. encedon*, *P. angolanus*, *P. lucretia*, *N. saclava*, and *G. saba*; *C. neanthes* and *P. archesia* above the two last-named insects and *P. clelia* not below them. *C. neanthes* and *P. archesia* not below *P. angolanus* or *P. lucretia**.

Exp. 27.—*May* 25. Had been allowed no food since a good meal, possibly three hours before, and semed distinctly hungry. She readily ate *Neptis goochi*, refused emphatically and persistently without tasting a *Terias senegalensis*, then stretched out eagerly for *Neptis goochi*, crushed and at once swallowed it, readily ate, after crushing it, *Herpœnia eriphia* and, with some hesitation, the previously-refused *Terias* (now stripped of wings), ate a *Nychitona medusa* and *Phrissura isokani* ♂ (the last with a front wing attached; all the others, unless otherwise stated, with one hindwing), then tasted and rejected *Mylothris yulei* with very evident dislike, but readily ate a *Rhopalocampta* with distinct *Amauris*-smell. The eating of the *Nychitona* and *Terias* was probably the result of immediately preceding stimulation.

I now gave her a *Charaxes brutus natalensis* and one *Charaxes candiope*, after eating which she tasted and very readily swallowed *Neptis goochi* and refused very persistently without tasting the wingless body of *Terias senegalensis*, once leaning forward and half tasting but drawing back without attempting to remove it from the forceps. She crushed, however, and readily ate *Phrissura isokani* and a

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* Some of the acceptances in this experiment may have been the *result* of stimulation: I have made the necessary allowances for this in carrying out these results to the final list.

♀ *Papilio lyæus.* She now readily ate two *Charaxes brutus natalensis*, tried unhesitatingly and rejected *Neptis agatha*, refused persistently without tasting *Phrissura isokani*, but tried and this time ate a second *Neptis agatha*, following it up by a *Henotesia* and a *Leuceronia thalassina*.

She ate readily a *Charaxes brutus natalensis* and a *Charaxes candiope*, tasted and very promptly rejected *Neptis agatha*, refused to touch *Neptis goochi*, tasted and rejected *Phrissura isokani*, *Leuceronia thalassina*, and *Neptis goochi*, but ate, after tasting it, *Atella phalantha*. She now tasted and rejected a second *Leuceronia thalassina* ♂, tasted and ate a *Byblia*, tasted and at once rejected a *Mycalesis campina*, refusing it persistently without tasting on its being reoffered, crushed and readily ate *Eurytela dryope* and *Rhopalocampta pisistratus* (with a slight bug-like smell).

She now readily ate two *Charaxes brutus natalensis*, one *Charaxes neanthes*, one *Sarangesa*, one *Papilio lyæus*, one *Pyrameis cardui*, one *Precis cebrene*, and two *Charaxes candiope*, the second being swallowed with a little difficulty, due, I thought, to repletion. *Charaxes neanthes* was readily eaten, *Sarangesa*, *Atella phalantha*, and *Eurytela dryope* refused without tasting, *Precis cebrene* accepted, crushed, and swallowed, the *Sarangesa*, *Atella*, and *Eurytela dryope* once more refused, a *Pyrameis cardui* accepted, crushed, and eaten, the *Sarangesa*, *Atella*, and *Eurytela* refused without tasting for the third time, as also a *Lampides bœtica*, but a *Rhopalocampta libeon* was tasted and readily eaten, another skipper (probably a *Gegenes*) refused without tasting, a *Melanitis leda*, offered both with wings and without, crushed each time and tossed away, a *Precis cebrene* refused for a moment, then taken, tasted, and readily swallowed, as was also a *Pyrameis*: and a *Precis clelia* and a *Precis cebrene* refused without tasting. The bird now accepted *Charaxes brutus*, played with it for a while, continually tossing it up into the air and catching it again, and finally tossed it aside, apparently replete.

[SUMMARY :—

(1) After the refusal of *M. yulei* the following were eaten : 1 *Henotesia perspicua*, 2 *C. neanthes*, 6 *C. brutus*, 4 *C. candiope*, 1 *N. goochi*, 1 *N. agatha*, 1 *A. phalantha*, 1 *Byblia* sp., 1 *E. dryope*, 3 *P. cardui*, 3 *P. cebrene*, 1 *P. isokani*, 1 *L. thalassina*, 2 *P. lyæus*, 1 *Rhopalocampta* (sp. ?), 1 *R. pisistratus*, 1 *R. libeon*, 1 *Sarangesa*.

(2) After the refusal of *T. senegalensis* were eaten: all the above except 1 *C. brutus*, 1 *C. candiope*, the *N. goochi*, and the *Rhopalocampta* sp.—these not offered.

(3) After *N. agatha* (finally), *N. goochi*, *P. isokani*, and *L. thalassina* were refused, the bird ate 2 *C. neanthes*, 2 *C. brutus*, 2 *C. candiope*, 1 *A. phalantha*, 1 *Byblia* sp., 1 *E. dryope*, 3 *P. cardui*, 3 *P. cebrene*, 1 *P. lyæus*, 1 *R. pisistratus*, 1 *R. libeon*, 1 *Sarangesa*.

(4) After the refusal of the *Mycalesis campina* there were eaten the species just enumerated in (3), excepting the *Atella* and *Byblia*—but the *Mycalesis* was apparently not *higher* than the latter.

(5) After the refusal of the *Sarangesa*, *Atella*, and *E. dryope* the bird ate 2 *P. cardui*, 2 *P. cebrene*, 1 *R. libeon*.

(6) After the refusal of *L. bœtica*, 1 *P. cebrene*, 1 *P. cardui*, and 1 *R. libeon* were eaten.

(7) After the refusal of the *Melanitis* and the *Gegenes*, 1 *P. cebrene* and 1 *Pyrameis* were eaten, each of these species and a *C. brutus* being then refused.

(8) Out of some of these placings it seems possible to extract the following grades :—

1. *P. cardui*, *P. cebrene*, *R. libeon.* } *Charaxes* spp., *Byblia* spp., *P. lyæus,*
2. *A. phalantha*, *E. dryope*, *Sarangesa.* } and *R. pisistratus* hereabouts.
3. *N. agatha*, *P. isokani*, *N. thalassina*, *N. goochi.*
4. *M. yulei*, *T. senegalensis* (this last not tested against *N. goochi,* than which it is at any rate apparently not higher).

(9) *M. yulei*	refused at	32	(incl.	10	large *Charaxes*)	from repletion:	might have gone lower.
T. senegalensis	,,	28	(,,	8	,, ,,)	from repletion:	eaten with hesitation at 34.
N. agatha	,,	19	(,,	4	,, ,,)	from repletion:	eaten at 23.
N. goochi	,,	19	(,,	4	,, ,,)	,, ,,	,, 28.
L. thalassina	,,	19	(,,	4	,, ,,)	,, ,,	,, 21.
P. isokani	,,	19	(,,	4	,, ,,)	,, ,,	,, 27.
M. campina	,,	17	(,,	4	,, ,,)	,, ,,	: might have gone lower.
Sarangesa	,,	5	(,,	0	,, ,,)	from repletion:	eaten at 11.
A. phalantha	,,	5	(,,	0	,, ,,)	,, ,,	,, 18.
E. dryope	,,	5	(,,	0	,, ,,)	,, ,,	,, 16.
L. bœtica	,,	3	(,,	0	,, ,,)	,, ,,	: might have gone lower.
Melanitis and *Gegenes*	,,	2	(,,	0	,, ,,)	from repletion:	might have gone lower.

The above gives a rough idea of the placing, relatively to repletion-point, of some of the species used. In particular, it seems to show that *M. yulei* and *T. senegalensis* are placed very low.]

Exp. 28.—*May* 27. Refused most persistently a *Nychitona medusa*, but ate readily after crushing each an *Atella phalantha* and a *Lampides bœtica*. She then accepted, crushed, and, after hesitation, swallowed a *Terias*, refused without tasting a wingless *Acræa esebria,* tasted and emphatically rejected *Nyctemera leuconoë* (with tomato-leaf smell), and refused persistently without tasting a *Mylothris agathina.*

She now ate readily two *Charaxes brutus* and after them, tasting each and then swallowing it without the least hesitation, *Neptis agatha* and *Eurytela hiarbas,* tasted and rejected a *Belenois mesentina*, but readily ate, after tasting it, a *Leuceronia thalassina.* She then persistently refused a *Terias* and a *Myc. campina* without tasting them, each with one wing, ate two more large *Charaxes* and a *Leuceronia argia* and then with increasing slowness four more large *Charaxes.* The next *Charaxes* was refused through sheer repletion, as also several other butterflies including *Pyrameis cardui*, *Precis cebrene*, and *Lampides bœtica.*

[Summary :—*Charaxes* spp. (and perhaps *L. argia*) were preferred to *Terias* and *M. campina*, and, with *L. thalassina,* to *B. mesentina*, with *C. brutus* and

L. thalassina (and perhaps *N. agatha* and *E. hiarbas*) to *A. esebria*, *N. leuconoë*, and *M. agathina*, and with *Atella* (and perhaps *L. bœtica* and *Terias*) to *N. medusa*. *A. esebria*, *N. leuconoë*, and *M. agathina* probably not above *Terias*, above *N. agatha* or *E. hiarbas*, *Terias* or *M. campina* over *L. thalassina*, or *P. cardui*, *P. cebrene*, or *L. bœtica* over the large species of *Charaxes* eaten at the end.]

Exp. 29.—*May* 28. After a longish fast, hungry in manner. Crushed and at once ate *Terias senegalensis*, wingless. I then gave a *Mylothris agathina*. She crushed and quite evidently disliked it, but hesitated as though almost persuaded by her appetite to swallow it nevertheless, then threw it away. She then readily accepted and swallowed a *Belenois mesentina* with no sign of dislike.

Next, after eagerly eating two *Charaxes cithæron*, offered as usual in the case of the larger *Charaxes* without wings, she tasted well and at once rejected a *Terias*. There could be no doubt as to her present dislike for it.

Then, after one *Charaxes brutus* and one *Charaxes candiope*, she crushed and ate a thorax of a wingless *Phrissura isokani*, having snatched it away so that the abdomen remained in the forceps. I now offered this (the abdomen) and it was crushed and thrown away.

I then gave the bird another *Charaxes brutus natalensis* and another *Charaxes candiope* and offered her three times a wingless *Pseudacræa lucretia* (gravid ♀). It was each time thoroughly tasted and tossed away, and a ♂ with one wing was similarly crushed and rejected. The bird then tasted and rejected a *Byblia* but readily enough ate the next two. The next (a different individual from the first) was, however, rejected. She now ate readily after thorough crushing a *Papilio demodocus* with one wing, but tasted and emphatically rejected a *Mycalesis campina*, immediately afterwards readily eating a *Leuceronia thalassina* ♂ (wingless). A ♀ *Phrissura isokani* (with one wing) was now refused without tasting but finally crushed and at once swallowed.

The bird now ate two *Charaxes candiope* and then accepted, tasted, hesitated for a second over and swallowed a *Leuceronia thalassina* ♀. She then tasted and readily ate a *Eurytela dryope* with one wing, but refused without tasting a wingless *Eurytela hiarbas*, possibly suspecting it of being a *Neptis*. Finally, however, she tasted it cautiously and, with an air of reassurance, swallowed it, readily ate a *Papilio lyæus* ♂ after crushing it well, again tasted and rejected the ♀ *Pseudacræa lucretia*, but crushed and readily ate an *Atella phalantha*. A *Byblia* was now crushed and eaten, the next tasted and rejected, a third tasted and readily eaten, a fourth with a slight musk-smell crushed and rejected emphatically, and a fifth refused persistently without tasting. She then crushed and readily ate a *Melanitis leda* and a *Precis archesia* (each with one wing), also a *Hamanumida dædalus* and a *Precis ceryne*.

A *Charaxes brutus natalensis* and a *Charaxes cithæron* followed and, after them, a *Charaxes neanthes* and a *Pyrameis cardui* were eaten, both most readily. She then crushed a *Henotesia perspicua*, wavered a good deal over it, but finally threw it away and wiped her bill, and tasted and very promptly rejected *Myc. campina*.

A *Charaxes brutus natalensis* and a *Charaxes cithæron* were now once more accepted and eaten. The roller was then twice offered a *Papilio lyæus* ♀ and each time tasted it well and rejected it, but tasted and most readily ate a *Precis archesia*, a *Hamanumida dædalus*, a *Pyrameis*, a *Precis cebrene*, and a *Sarangesa*.

She then readily ate a *Charaxes candiope*, a *Charaxes brutus*, a *Precis cebrene*, and a *Byblia*, but crushed and rejected the next *Byblia* and the ♀ *Pseudacræa lucretia*. She was, however, probably now replete, as evidenced by the fact that she persistently refused without tasting *Charaxes brutus*, *Hamanumida dædalus*, *Precis cebrene*, and *Lampides bœtica*.

[SUMMARY :—

(1) After *M. agathina* was rejected the bird ate 1 *Melanitis leda*, 1 *C. neanthes*, 4 *C. cithæron*, 5 *C. brutus*, 5 *C. candiope*, 5 *Byblia*, 1 *E. dryope*, 1 *E. hiarbas*, 1 *A. phalantha*, 2 *P. cardui*, 2 *P. cebrene*, 2 *P. archesia*, 1 *P. ceryne*, 2 *H. dædalus*, 1 *B. mesentina*, 1½ *P. isokani*, 1 ♂ and 1 ♀ *L. thalassina*, 1 *P. demodocus*, 1 *P. lyæus*, and 1 *Sarangesa* (*M. agathina* rejected 40 places, including 14 large *Charaxes*, from repletion-point).

(2) After rejecting a *Terias* she ate all these less the *B. mesentina* and 2 *C. cithæron* (*Terias* rejected 37 places, including 12 large *Charaxes*, from repletion-point).

(3) After rejecting the ♂ and ♀ *P. lucretia* she ate all in list (1) except the *Belenois* and the 2 *C. cithæron* just mentioned and except 2 *C. brutus*, 2 *C. candiope*, and the *P. isokani* thorax (*P. lucretia* rejected 32 places, including 8 large *Charaxes*, from repletion-point).

(4) After rejecting *M. campina* she ate list (1) with the exceptions already mentioned and the further exceptions of 2 *Byblia* and the *P. demodocus* (=29 places).

(5) After rejecting the last of the main lot of Byblias she ate 1 *M. leda*, 1 *C. neanthes*, 2 *C. cithæron*, 3 *C. brutus*, 3 *C. candiope*, 1 *Byblia*, 2 *P. cardui*, 2 *P. cebrene*, 2 *P. archesia*, the *P. ceryne*, 2 *H. dædalus*, and the *Sarangesa* (=21 places).

(6) After rejecting *H. perspicua* (so waveringly that she may have been nearly hungry enough for it) she ate 1 *C. cithæron*, 2 *C. brutus*, 1 *C. candiope*, 1 *P. cardui*, 2 *P. cebrene*, 1 *P. archesia*, 1 *H. dædalus*, 1 *Byblia*, and the *Sarangesa* (=11 places).

(7) After rejecting *P. lyæus* she ate these less 1 *C. brutus* and the *C. cithæron* (=9 places including only 2 large *Charaxes*).

(8) *Terias senegalensis* probably not liked less than *M. agathina*; *P demodocus* than *M. campina*; *P. lyæus* than *Ps. lucretia*; the last *Byblia* eaten not less than *C. brutus*, *M. dædalus*, or *P. cebrene*. Hesitation over *L. thalassina* ♀, probably due to its *Mylothris*-like appearance.

(9) By disregarding throughout the experiment the possibility of special stimulation (such as probably caused *Byblia* to be eaten to repletion-point) one might deduce much from this experiment. Taking it into account, all that can fairly safely be said with regard to preferences is that *P. archesia* was apparently preferred to *P. lyæus*, and, with *C. brutus*, to *H. perspicua* (which on manner may have been preferred to *M. campina*); with *C. brutus* and *M. leda* to "unstimulated" *Byblia*; with *C. brutus*, *M. leda*, and *A. phalantha* to *P. lucretia*; with these three and *L. thalassina* ♂ to *M. campina*; with these four and *P. demodocus* to, again, *Byblia* and *P. lucretia*, also to *Terias* and perhaps *P. isokani*; and with these five and *B. mesentina* to *M. agathina*.]

Exp. 30.—*May* 29. To "place" *Pseudacræa lucretia* var. *expansa.*

After a longish fast, hungry in manner, the roller crushed and swallowed a *Mylothris agathina*, but in this case showed afterwards signs of dislike—shakings of head, etc. Evidently she was only just hungry enough to eat it.

I now gave her two *Charaxes brutus natalensis*, after which *Belenois mesentina* was tasted and rejected, but on being reoffered was swallowed rather under protest, the bird afterwards shaking its head a good deal. She then very readily and with no sign of dislike crushed and ate a *Neptis saclava* and a wingless *Pseudacræa lucretia expansa* (gravid ♀ of yesterday still alive).

She now eagerly ate two *Charaxes candiope*, afterwards tasting and rejecting *Neptis saclava*, refusing *Neptis goochi* without tasting and crushing well and rejecting *Pseudacræa lucretia expansa* with one wing. Reoffered, it was again tasted and at once rejected. *Neptis saclava* was then tasted and swallowed after a momentary hesitation. *Pseudacræa lucretia expansa* reoffered yet again was refused without tasting, but finally taken, crushed, and, after a moment's hesitation, swallowed. A *Neptis goochi* was now refused without tasting and a *Neptis saclava* crushed and rejected. A *Phrissura isokani* without smell or wing was then at first refused without tasting, finally tasted slightly and rejected, the bird wiping her bill.

She now readily ate two *Charaxes brutus natalensis*, then tasted and rejected *Eurytela hiarbas.*

I then gave her four *Charaxes natalensis* in succession. She refused the next, then crushed carelessly and dropped an *Atella phalantha*, and refused without tasting *Precis cebrene* and *Pyrameis cardui.* However, on my now placing grasshoppers in the cage she descended and ate four or five very small ones (not equivalent to two *Charaxes*) before returning to her perch satisfied.

[SUMMARY :—

(1) As to the *Pseudacræa*'s placing, it was eaten with *N. saclava* and rejected at the same point as the latter, and when the *Neptis* was eaten with disinclination it too required a little persuasion of the roller to induce her to eat it. That the hesitation here was slightly more prolonged than in the case of the *Neptis* might have been merely the result of the eating of the latter in between.

I wrote at the time "Any onlooker must have been convinced that the roller found nothing to choose between the decisive *Pseudacræa* and *Neptis saclava.*"

(2) Grades :—

1. Small grasshoppers (sp. not stated).
2. *C. brutus.*
3. *N. saclava* and *P. expansa.*
4. *B. mesentina* and *M. agathina.*

} *N. goochi* tried less readily each time than *N. saclava.*]

Exp. 31.—Later in the day, after some starvation, hungry in manner but less so than the first time.

I twice offered a wingless *Nychitona medusa* and it was each time tasted and at once most emphatically flung away. *Neptis saclava*, however, was readily accepted and eaten.

The bird then ate two *Charaxes natalensis*, tasted and rejected a *Myc. campina*, tasted and readily ate in quick succession a *Eurytela hiarbas*, a *Neptis saclava*, two *Henotesia perspicua*, and a *Myc. campina*.

She then ate two *Charaxes cithæron*, a *Myc. campina*, and another *Eurytela hiarbas*.

After two more *Charaxes* (*C. brutus*) she tasted very thoroughly, being evidently doubtful or disinclined, and finally rejected a *Mycalesis campina*, thoroughly tasted, and had nearly swallowed but once more brought up and threw away a *Neptis saclava*, refused without tasting a *Neptis agatha*, finally tasting it very slightly if at all and again refusing it. She then crushed and ate very readily a *Sarangesa*, refused at first a *Eurytela hiarbas*, quite likely taking it for a *Neptis*, but then tasted it and, apparently reassured, swallowed it without further hesitation. She then readily ate, after crushing each well, a *Papilio lyæus* ♀ and a *Papilio dardanus* ♂ (with decided bean-smell), tasted slightly and refused *Rhopalocampta forestan* (with a very strong smell—a mixture of prunes and *Amauris*) with much subsequent shaking of her head and wiping of her bill, readily ate a *Charaxes candiope*, but, evidently replete, crushed and threw away a *Charaxes brutus natalensis*, afterwards refusing *Precis cebrene*, *Sarangesa*, and *Pyrameis cardui* without tasting.

Fifteen minutes later she again refused all these butterflies and a *Charaxes candiope*.

[SUMMARY :—

(1) Rejected *N. medusa*, ate 4 *C. brutus*, 2 *C. cithæron*, 1 *C. candiope*, 2 *N. saclava*, 3 *E. hiarbas*, 3 *M. campina*, 2 *H. perspicua*, 1 *P. lyæus*, *P. dardanus* ♂, 1 *Sarangesa*.

(2) Rejected *N. saclava*, *N. agatha*, *M. campina*, ate *E. hiarbas*, *C. candiope*, *P. lyæus*, *P. dardanus* ♂, *Sarangesa*.

(3) On manner: after the last 2 *C. brutus* the rejections of *N. saclava* were less decided than that of *M. campina*. I commented at the time: "That this insect (*M. campina*) is less liked than *N. saclava*, though possibly very near it, I felt no doubt when witnessing the bird's treatment of each after the sixth *Charaxes*, when she had barely arrived at the *Neptis*-rejecting stage but emphatically rejected *Mycalesis*."

(4) Grades :—

1. *E. hiarbas*, *Sarangesa*, *C. candiope* (and perhaps *P. lyæus* and *P. dardanus* ♂).
2. *N. saclava*, on manner above.
3. *M. campina*.
4. *N. medusa*.

E. hiarbas, *N. saclava*, and *H. perspicua* were eaten after the rejection of a *Myc. campina*, and the acceptance of the latter butterfly immediately afterwards was probably due to their stimulating effect, as may have been several other acceptances which I have accordingly omitted from the table.]

The bird brought the last *Neptis* acceptance unusually close up to apparent repletion-point—probably the result of stimulation.

Exp. 32.—*May* 30. Very hungry. Tasted and at once emphatically rejected *Nychitona medusa* but readily ate, after tasting each, *Mylothris yulei*, *Mylothris rueppelli*, and *Mylothris agathina* ♂. She then tasted thoroughly and finally rejected *Nyctemera leuconoë* (with slight tomato-leaf smell), crushed and at once threw away a second *Nychitona medusa*, but quite readily ate a *Mylothris yulei* ♀.

She now eagerly accepted, crushed, and swallowed a *Charaxes candiope* and a *Charaxes natalensis*, and immediately afterwards a *Mylothris agathina* ♂ with very little smell. A *Mylothris yulei* ♂ with very decided sweet-brier smell was now tasted and dropped, perhaps accidentally, and eaten readily on being reoffered.

Two *Charaxes candiope* were now eagerly eaten, and immediately afterwards a *Mylothris yulei* (smelling of urine) readily.

Two *Charaxes natalensis* were now eaten. I then offered *Mylothris agathina* ♀, little or no smell. It was at first persistently refused without tasting, but finally well tasted and thrown away. The bird then readily ate, after tasting each, *Precis cebrene*, *Belenois severina* (with honey-scent), and *Neptis agatha*.

Then a *Charaxes cithæron* and a *Charaxes natalensis*, after which *Neptis goochi* was persistently refused without tasting. On my now, however, substituting for it a *Neptis agatha* the bird tasted this waveringly and dropped it, but crushed and ate it on its being reoffered. *Neptis goochi* and *Neptis saclava* were now persistently refused without tasting, *Byblia* was tasted and dropped, *M. campina* tasted and at once hastily thrown away, *Leuceronia argia* ♀ crushed and very readily eaten, *Henotesia* (not of forest) offered without wings cautiously and suspiciously tasted and finally rejected. The bird now refused without tasting *Phrissura isokani*, but on my continuing to hold it to her it was carefully tasted and swallowed. A *Eurytela dryope* was then tasted somewhat suspiciously and dropped, but more boldly tasted on being reoffered and this time readily eaten. The bird now refused to touch *Tarucus plinius*, but tasted and ate a Satyrine of the species rejected shortly before (not the same individual). She then tasted and readily ate a *Gegenes* (yellow) and an *Atella phalantha*.

Two *Charaxes brutus* were now eaten, *Cacyreus lingeus* refused persistently without tasting, *Leuceronia thalassina* ♂ well tasted and thrown away, *Catopsilia florella* ♂ at first refused without tasting but finally subjected to careful and prolonged tasting and eaten without sign of dislike. *Precis archesia* was then crushed and eaten with the greatest apparent relish, a *Gegenes* of previous species was twice well tasted and rejected, an *Atella phalantha* was crushed and readily eaten, but a *Byblia* refused without tasting, as was also a *Eurytela hiarbas*. A *Eurytela dryope* was however eaten most readily, a *Phrissura isokani* refused without tasting, a *Precis cebrene*, *Precis elgiva*, *Precis natalensis* ⊙ f., *Hamanumida dædalus*, and *Charaxes neanthes* readily eaten, each after the usual crushing, and a *Byblia* (not offered before) well tasted and rejected.

An interruption of a few minutes now occurred—enough probably to make the roller slightly hungrier. After it a skipper (dark) was tasted and rejected, but a *Catopsilia florella* eaten readily, and after it in quick succession a *Leuceronia* (♂), a *Leuceronia argia* ♀, and the *Leuceronia thalassina* ♂ previously rejected, also a *Charaxes achæmenes*.

Charaxes pollux, *Charaxes cithæron*, *Pyrameis cardui*, and *Precis cebrene* were now eaten, a yellow *Gegenes* not offered before was well tasted and rejected, and *Eurytela hiarbas*, offered with the disguise of a *Pyrameis* wing in place of its own, was well tasted and rejected. None of the three rejected skippers had any appreciable smell.

Charaxes brutus natalensis, *Precis cebrene*, and *Charaxes cithæron* were now all readily eaten, and after them *Atella phalantha*, *Precis archesia*, and *Hamanumida dædalus*, each after the usual tasting.

Charaxes candiope and *Charaxes cithæron* were now eaten with difficulty, and a second *Charaxes cithæron* merely played with and finally tossed away and refused on being reoffered. The bird now refused without tasting *Precis elgiva* and *Pyrameis cardui*, but, finally changing her mind, accepted and ate the latter. *Precis cebrene* was then refused without tasting and a *Pyrameis cardui* accepted and eaten. A second *Pyrameis*, however, was persistently refused without tasting, though offered repeatedly at intervals.

[SUMMARY:—

(1) Extracts from my comments made immediately after the experiment:

"The bird started distinctly hungry and remained in excellent brisk tasting form from start to finish.

"There could be not the slightest doubt that the Nychitonas were far more disliked than any species of *Mylothris*. They were quite fairly tasted and then thrown away with marked disgust, whereas all three species of *Mylothris* were, up to the sixth *Charaxes*, eaten, after tasting, without the slightest hesitation. *Nyctemera* too was almost certainly liked better than *Nychitona*, being kept in the mouth much longer and not pitched away with the same emphasis. It was, however, very decidedly disliked. The rejected *Mylothris* lacked the heavy menthol-smell that so often characterizes *M. agathina* ♀, but *M. yulei* of each sex had the usual urine and sweet-brier scents, respectively, well developed. The *Belenois* (a ♂) smelt of honey (the first individual in which I have noticed this, captured by myself in the coffee-plantation) and was decidedly better liked than a ♀ *M. agathina* with almost no scent. The *Mycalesis* was quite likely less liked than the *N. agatha* or the *Byblia*, judging from the far prompter manner of its rejection . . . . The *Eurytela hiarbas* offered under guise of *P. cardui* seemed to secure a perfectly genuine tasting and was probably rejected on its own merits and unconfused with *Neptis*. . . ." I also recorded my impression from this and previous experiments that *N. agatha* is somewhat more readily attacked than *N. goochi*.

(2) Some grades:

Many of the acceptances were doubtless in part due to special stimulation by the preceding acceptance. Omitting these, and assuming for convenience that *L. thalassina* and *L. argia* were approximately equally liked, the order of preference would be roughly—

M. yulei.	1. *P. archesia* ⊙ f.	*E. dryope.*
	2. *C. florella.*	*H. perspicua.*
	3. *L. thalassina*, *L. argia.*	*P. isokani.*
	4. *N. agatha.*	*T. plinius.*
N. goochi.	5. Perhaps *M. agathina.*	*H. lingeus.*
	6. *N. leuconoë* (on manner).	*Byblia.*
	7. *N. medusa.*	*M. campina.*
		N. saclava.

It is possible that even the eating of *Atella* and *E. dryope* at the end may have been influenced by that of the much-liked *P. archesia* shortly before. At any rate, *Atella* was preferred to *Gegenes*, *E. dryope* to *E. hiarbas*, *Gegenes* and *Byblia*, and *P. cebrene* to these and to *P. isokani.*

After the interruption *C. florella* was preferred to the dark skipper and *P. cardui* to (probably) the last-named, to *Gegenes*, to *E. hiarbas*, *C. cithæron*, *P. elgiva*, and (more certainly) to *P. cebrene*, and *C. brutus* to the *Gegenes*, *Eurytela*, and dark skipper.

(3) Some interesting points in the experiment were (as will appear better later) the high placing of *Atella* (stimulated ?), the more consistent placing of *Byblia* as low as it has remained in subsequent experiments, the low placing of the Lycænids untasted. and the placing of the skippers. The roller seemed more inclined for *N. agatha* than for *N. goochi*, but her treatment of the former and shortly afterwards of *P. isokani* would seem to indicate that she was barely hungry enough even for them. The first rejection of *H. perspicua* was quite possibly in part due to suspicion of the not dissimilar *M. campina*—and even tasting does not always dissipate suspicion,—and it is possible that its acceptance later more accurately indicates its own standing. Similarly, the initial hesitation over *E. dryope* and *C. florella* may have been due to suspicion of something more unwelcome: thus a ♂ *L. thalassina* for which the bird was insufficiently hungry had immediately preceded the offering of the *Catopsilia*. The same might have applied to the other *Eurytela* refused without tasting, but hardly, I think, where I offered it disguised as a *Pyrameis*, and I believe the evidence in this experiment indicating that *E. hiarbas* was placed slightly below its congener to be probably reliable.]

Exp. 33.—*May* 31. After a fast and rather hungry in manner. Tasted and at once rejected *Nychitona medusa*, then tasted well and rejected *Acræa johnstoni* and *Nyctemera leuconoë* (with tomato-leaf smell), ate two *Charaxes cithæron* and tasted and at once rejected *Terias brigitta*, *Belenois severina*, and *Danaida chrysippus*, and tried and rejected a *Myc. campina*, but crushed and readily ate *Eurytela hiarbas*, *Neptis goochi*, *Neptis agatha*, a small blackish skipper (probably of same species as rejected yesterday), *Neptis saclava*, two *Byblia*, and a Satyrine.

She later ate two *Charaxes brutus*, and after them a *Neptis saclava*, a *Neptis agatha*, and a *M. campina*, refused without tasting a *Terias brigitta*, crushed and swallowed rather waveringly the previous *Belenois* (now wingless), once more persistently refused the *Terias* without tasting, but readily ate a *Byblia*, ate two *Charaxes ethalion*, three *Precis cebrene*, a *Pyrameis cardui*, a *Neptis saclava*, and a

Mycalesis campina. I had no more *Charaxes*, so did not proceed with the experiment.

[SUMMARY :—

Much special stimulation probably occurred in this experiment too, and about all that can be fairly safely deduced is—

E. hiarbas.
1. *Byblia* (on manner above *Belenois*).
2. *B. severina.*

T. brigitta (not above *M. campina*).
3. (Probably) *A. johnstoni* and *Nyctemera leuconoë.*
4. *N. medusa.*]

D. chrysippus.
M. campina.

Exp. 34.—*June* 1. To place *Euphædra neophron* :

This experiment was carried out by my wife in my absence from home. A *Euphædra* had been captured and I was anxious to have it "placed." I left instructions to fill up to repletion-point on any food that might be available and then to offer the *Euphædra.* My wife states that the bird's ordinary food had not yet come in, and so she used meat and such butterflies as were available for the filling-up process. She offered the latter mostly as they came and without any real attempt to elicit preferences.

The bird seemed hungry and ate eagerly five or six small pieces of meat, refused without tasting a *Terias*, readily ate a *Eurytela dryope*, again refused the *Terias*, readily ate *Eurytela hiarbas*, *Neptis saclava*, and a piece of meat, but refused a second piece, once more readily ate *Eurytela hiarbas*, and refused without tasting *Neptis goochi*, but ate it on its being reoffered as also a *Leuceronia thalassina* and *Eurytela hiarbas.* She then once more refused a piece of meat, but readily ate a *Leuceronia thalassina*, a *Precis cebrene*, two *Eurytela dryope*, a *Henotesia*, a *Eurytela hiarbas*, and a *Tagiades flesus*, and again refused a piece of meat, then once more readily ate *Leuceronia thalassina*, *Eurytela dryope*, *Neptis saclava*, and a Satyrine, tasted well and rejected a skipper (yellowish), but once more carefully crushed it on its being reoffered and this time ate it as also a *Henotesia* and *Eurytela dryope.* A ♂ *Papilio lyæus* was, however, twice rejected after thorough tasting and the third time refused without tasting, as were also *Neptis saclava* and a *Byblia*—the bird had turned her back on being offered the *saclava.* My wife persisted in offering the *Byblia* with much coaxing, and the roller finally turned round and ate both it and the *Neptis saclava*, but persistently refused a second *saclava* without tasting. It then tasted and rejected the *Papilio lyæus* previously disapproved of, but crushed and readily ate another. The first was now picked up and once more reoffered, and still obstinately refused without tasting. *Neptis saclava* was now twice with an interval between most persistently refused, but a *Charaxes* was eaten, though a *Charaxes brutus natalensis* was then crushed and dropped. Nevertheless, the bird now examined for a second and tried, crushed, and swallowed down with apparent relish the abdomen with more than half the thorax of *Euphædra neophron* (one wing attached). *Charaxes brutus* was then accepted, crushed and dropped, and the head and smaller portion of *E. neophron*, thorax with one forewing attached, was offered. The bird leant forward evidently tempted to take it, but changed her mind and withdrew when in the very act of closing her bill on it. On its being reoffered she ignored it. She then took but simply dropped *Papilio lyæus*, also, twice in succession, *Charaxes brutus*, ignored on re-presentation the *P. lyæus*, the *E. neophron* (head, &c.), and a *Henotesia perspicua*, ignored for some time *Atella phalantha* but finally took it listlessly in the point of her bill and dropped it, refused for a time a *Precis cebrene* but finally after a lot of coaxing accepted and ate it, accepted and thoroughly crushed the *Euphædra* head and thorax and kept it in her bill for a considerable time as she did so, but in the end threw them away uneaten, and on my wife's reoffering them accepted but tossed them aside—they had now in any case been reduced to pulp—refused *Neptis saclava*, clapping her bill and shaking her head in sign of strong unwillingness, and ignored *Papilio lyæus* and *Charaxes brutus*. A few minutes later she repeatedly refused or accepted and threw aside *Charaxes brutus*.

[SUMMARY:—

(1) Refused *Terias*, ate (up to the few minutes' interval occupied in coaxing) 5 *E. dryope*, 4 *E. hiarbas*, 3 *N. saclava*, 1 *N. goochi*, 1 *P. cebrene*, 1 *Byblia*, 3 *L. thalassina*, 1 *P. lyæus*, 2 *H. perspicua*, 1 Satyrine, 1 *Tagiades flesus*, 1 other skipper.

(2) Refused meat (sp.?), ate all the above except 1 *E. dryope*, 1 *E. hiarbas*, 1 *N. saclava*, and 1 piece of meat

(3) After the interval she refused *N. saclava*, ate *Charaxes* sp., most of *E. neophron*, and a *P. cebrene*.

(4) Grades:

L. thalassina, *E. hiarbas*, *E. dryope*, and probably *N. goochi*.
1. *Charaxes* sp., *E. neophron*, and probably *P. cebrene*.
2. *N. saclava* (if unstimulated), yellow skipper, and, on manner, a *P. lyæus*.
3. Meat and *Terias*.

(5) The roller was probably overpersuaded in the matter of the *Byblia* and *N. saclava*, for turning her back was her final and most emphatic form of refusal, reserved usually for importunity that had already become irksome. The eating of the two insects above their grade would probably have inhibited appetite and would thus account for the refusal so soon of a *Charaxes*. That the *Euphædra* was, nevertheless, then eaten showed that its first impression on the roller was a very highly favourable one, and that the bird was later evidently much tempted to eat the rest of it at a time when she ate *P. cebrene* only under persuasion suggests that she in no way regretted her previous acceptance of it. It seemed to be preferred to *Charaxes brutus*.]

Exp. 35.—*June* 5. Hungry, was given two very large hard Acridians (*Acridium lineatum*, Stoll), battered and ate them readily enough, and after them a wingless *Precis cebrene*, accepted equally readily a wingless *Neptis saclava*, but on tasting it at once threw it away, ate a *Charaxes brutus natalensis* and a *Charaxes candiope*, crushed and dropped an *Atella phalantha*, refused but after coaxing accepted and ate a *Precis cebrene*, refused without tasting an *Atella phalantha*, and crushed and tossed aside a second *Precis cebrene*.

[Those huge Acridians were probably very filling. Often given to this and other birds as part of their ordinary food, they were usually eaten only when (1) the bird was hungry, or (2) I had first reduced them with a hammer. Under the latter circumstances they have been eaten by various birds up to near repletion-point, and it is probable that their great hardness and size and spiky legs are a very needed as well as a very efficient protection. Their habits are not specially procryptic.

The very prompt rejection of *Neptis saclava*, on taste, after a quite unsuspecting acceptance, is highly convincing. Preferred to it were *Charaxes brutus* and perhaps *Charaxes candiope*, also *Precis cebrene*. The last-named butterfly was apparently regarded as better worth considering than *Atella phalantha*.]

Exp. 36.—*June* 6. Extent of hunger uncertain; was feeding on grasshoppers and termites when I commenced the experiment. Readily ate *Precis cebrene*, two *Charaxes brutus*, a *Henotesia perspicua*, a third *Charaxes brutus* and a *Charaxes candiope*, refused, but immediately afterwards changing her mind, accepted, crushed, and readily swallowed a *Neptis saclava* and a *Mycalesis campina*, the latter with the usual chocolate smell, ate four *Charaxes brutus*, and thereafter persistently refused to touch *Neptis goochi*. *Neptis agatha* was, however, accepted, crushed, and eaten with apparent readiness, but *Neptis goochi* was once more refused without tasting. She then readily ate two *Henotesia perspicua*, a *Charaxes brutus*, and a *Charaxes candiope*, and tasted and rejected an *Ypthima*. On my reoffering it, it was again properly tasted, and this time flung to the other side of the cage. *Precis cebrene*, *Atella phalantha*, and a *Mycalesis campina* were now eaten without hesitation, but there was some delay between each of these last offerings as I had exhausted my prepared material and had to hunt up each separately in the envelopes and remove the wings.

[SUMMARY, &c.:—(1) After *N. goochi* was refused, 1 *N. agatha*, 2 *H. perspicua*, 1 *C. brutus*, 1 *C. candiope*, and 1 *P. cebrene* were eaten, the two *Charaxes* perhaps in part as the result of stimulation.

(2) After the rejection of *Ypthima*, *P. cebrene* was eaten. Whether *Atella phalantha* and (especially) *Mycalesis campina* could be safely added to the lists of "preferred" butterflies would depend entirely on the length of the delay before each was offered, quite apart from any appetizing influence that the *P. cebrene* may have exerted.

(3) *Comment at the time.*—"The roller's constant refusal of *Neptis goochi* without tasting seems significant—*cf.* past experiments. The *Ypthima* had the usual faint smell of lemonade."]

Exp. 37.—*June* 7. The bird was hungry. Not having many *Charaxes* I gave her a number of grasshoppers of many species. She then tasted and rejected *Neptis saclava*, but readily ate *Precis cebrene* and *Neptis agatha*. After eleven more small grasshoppers she readily, to my surprise, ate the *Neptis saclava*. I then gave five large grasshoppers. The bird had some difficulty in swallowing the last two, and they could be plainly seen in the back of her throat whenever she opened her bill. A *Neptis saclava* was now persistently refused without tasting, a *Pyrameis* was recognized and readily eaten, a *Byblia*, smelling slightly of civet (dark hind-wing with pearl spots), was tasted and thrown away with evident dislike, but a ♀ *Leuceronia argia* was eaten, as also a *Charaxes candiope*—the latter slowly, after being played with for a few seconds—and a *Charaxes vologeses* was simply played with and dropped, as were also a *Precis artaxia* and *Precis cebrene.*

Five minutes later, still apparently anything but hungry, she listlessly crushed and dropped *Precis artaxia* and *Precis antilope*, seemed to wake up on being offered a *Melanitis leda*, crushed and swallowed it, and after it crushed well and swallowed with apparent relish the *Precis artaxia* reoffered. *Atella phalantha* and *Precis antilope* were refused without tasting, a *Precis cebrene* accepted and eaten, a *Eurytela hiarbas* disguised with a *Pyrameis* wing well tasted and rejected, and an actual *Pyrameis* played with for some seconds and finally swallowed. The bird then, reappetized, ate with apparent liking, after crushing each, *Precis cebrene*, *Hamanumida dædalus*, and *Melanitis leda*, rejected, after tasting it, *Eurytela dryope*, but readily ate *Precis ceryne* and *Precis antilope.* She then took with disinclination, crushed slightly, and dropped *Atella phalantha* and *Eurytela dryope*; however, she was probably in any case replete, or nearly so, for she now persistently ignored *Precis cebrene*, crushed slightly and dropped *Precis natalensis* ⊙ f., and once more refused without tasting *Precis cebrene.*

Ten minutes later she again persistently ignored *Precis natalensis* ⊙ f. and *Precis cebrene.*

Five minutes later she refused a *Neptis saclava*, tasted and readily ate the *Precis natalensis* ⊙ f., then refused without tasting, but eventually accepted and ate, a *Precis cebrene*, and after it, with an effort (or with disinclination ?), a *Leuceronia thalassina* ♀ and a *Papilio dardanus* ♀ f. *hippocoon.* She now refused without tasting an *Atella phalantha*, crushed and readily ate a *Precis clelia*, persistently refused to touch a *Neptis saclava*, crushed and this time ate an *Atella phalantha*, and then persistently ignored *Hamanumida dædalus* and a *Rhopalocampta libeon.*

Five minutes later she crushed and ate with the greatest readiness a *Catacroptera cloantha*, refused without tasting *Neptis saclava*, the previously offered *Byblia* and *Papilio angolanus*, but most readily accepted a second *Catacroptera cloantha.* She was quite disinclined to eat and after playing with it (tossing it up, &c.) for a few seconds, dropped it, but on my at once reoffering the butterfly again accepted and this time crushed and swallowed it with apparent relish. She then refused without tasting *Precis ceryne*, *Rhopalocampta libeon*, a *Gegenes*, and a dark skipper, also a *Pyrameis cardui* and a *Precis cebrene.*

Five minutes later she crushed and dropped *Precis natalensis* ⊙, readily ate *Hamanumida dædalus* and the brown *Rhopalocampta*, refused obstinately without tasting the *Byblia*, tasted and emphatically rejected *Papilio angolanus*, crushed and readily ate *Charaxes vologeses*, refused without tasting *Precis natalensis* ⊙ f., and ate with relish *Pyrameis cardui* and *Precis ceryne.* I now offered, each with the underside of the wing up and therefore not altogether dissimilar, *Precis clelia* and *Eurytela dryope.* The first was crushed and readily eaten, the second accepted equally readily, crushed and thrown away. A *Rhopalocampta libeon* (no smell) was readily eaten, as were also a blackish skipper, a *Gegenes*, and a *Hamanumida dædalus. Precis natalensis* ⊙ f. was crushed and tossed aside.

Three minutes later *Melanitis leda* and a *Leuceronia thalassina* ♀ were eaten readily, but a *Sarangesa djælælæ* with a slight lemonade smell was tasted and at once rejected. On being reoffered it was refused persistently, though a *Melanitis* was readily eaten. A *Ypthima* was now refused without tasting, as was also a *Precis natalensis* ⊙ disguised with a *Melanitis* wing (incongruous, however, with the blue-black body), but a *Gegenes* without smell was eaten readily, as also a blackish skipper, though *Papilio angolanus* was refused with a shake of the head. After three or four minutes an *Ypthima* was thrice offered and each time well tasted and thrown away, two *Henotesia perspicua* were eaten readily, the *Ypthima* reoffered was tasted and again thrown away, *Eurytela dryope* was well crushed and readily eaten, and *Neptis saclava* was persistently refused without tasting.

The bird, however, was getting unmistakably hungrier, the result of slight delays between the offerings, and she crushed and without hesitation ate *Papilio angolanus*, but tasted and threw right away a *Byblia*. The *P. natalensis* ⊙ f. was now taken with disinclination, crushed slightly and thrown aside (emphasis far less than with *Byblia*), though *Precis clelia*, a *Melanitis leda*, a *Henotesia perspicua*, and two *Charaxes brutus natalensis* were eaten readily. I now offered another *Henotesia*, but this was refused persistently with shakes of the head, though *Hamanumida dædalus* was eaten readily.

Five minutes later the *Henotesia* was eaten readily enough, but a second of the same species crushed and rejected; a *Pyrameis* was eaten with apparent relish, but a *Byblia* refused persistently, and two more *Henotesia*, not yet offered, were well tasted and each in turn rejected.

[ANALYSIS AND SUMMARY:—The intervals serve to divide the experiment into nine sub-experiments:—

In the first, *P. cebrene* and *P. cardui* were each preferred to *Neptis saclava*, and *L. argia* ♀ and *C. candiope* to *Byblia*. *N. agatha* may have been preferred to its congener, but the possible reappetizing influence of the immediately preceding *Pyrameis* may have brought about its acceptance, as that of the eleven grasshoppers doubtless did the acceptance of the previously refused *N. saclava*. That *C. vologeses*, *P. artaxia*, and *P. cebrene* were refused even after *C. candiope* is evidence of a feeling of repletion.

In the second sub-expt., *Melanitis leda* was preferred to *Precis artaxia* and to *Precis antilope*, and its appetizing influence probably brought about the acceptance of the first-named *Precis* but failed to secure that of *Atella*, to which (and to *Precis antilope*) *P. cebrene* was preferred. *P. cardui* was preferred to *E. hiarbas* and (unless it was its influence that secured their eating) so may have been *P. cebrene*, *H. dædalus*, and *M. leda*. To *E. dryope* was preferred *P. ceryne*, and the subsequent eating of the *Eurytela* was quite likely due to the appetizing influence of the *Precis*. Here, again, repletion intervened and, ten minutes later, caused the failure of the

Third sub-expt.

Fourth. *P. natalensis* ⊙ f. preferred to *N. saclava*, as also *P. cebrene*, but it may have been some appetizing effect of the latter that caused the acceptance after it of *L. thalassina* ♀ and *P. hippocoon*, though it (and these) failed to get *Atella* eaten The latter was liked less than *P. clelia* but better than *N. saclava*, and was either finally eaten near repletion-point or itself, by inhibitory action, caused a premature rejection of *H. dædalus* and *R. libeon*.

Fifth. Even the eating of *Catacroptera* failed to secure that of *N. saclava*, *Byblia*, and *P. angolanus*, to all of which (and apparently at repletion-point) *Catacroptera* was preferred.

Sixth. *H. dædalus* and *P. cardui* both definitely preferred, *R. libeon, P. ceryne*, and *P. clelia* preferred, if their eating was not the result of a special stimulation of appetite, to *P. natalensis* ⊙ f.; *C. vologeses* preferred to *Byblia* and *P. angolanus*; *R. libeon* to *E. dryope*; blackish skipper and *H. dædalus* also to *E. dryope* if not a matter of special stimulation.

Seventh. The eating of *M. leda* may have influenced that of *L. thalassina*, but *S. djælælæ* (scented like *Ypthima*) was nevertheless refused and a second *M. leda* eaten in preference to it, while *Gegenes* was certainly preferred to *Ypthima* and to *P. natalensis* ⊙ f., as was, less certainly, the blackish skipper.

Eighth. *H. perspicua* and *E. dryope* both preferred to *Ypthima* and *H. dædalus* to *Henotesia*; *P. angolanus* to *N. saclava*, *P. natalensis* (on manner) to *Byblia*; and *P. clelia* (less certainly *M. leda*, *H. perspicua*, *C. brutus*) to both.

Ninth. *Pyrameis* preferred to *Henotesia* and, on manner, *Henotesia* to *Byblia*.

Summary :—It is not easy to compress these preferences into a single table, but the following attempt, to my mind, roughly represents the results of the experiment :—

L. argia ♀.	1. *P. clelia*, *P. ceryne*, *H. dædalus*, *P. cardui*, *C. cloantha*, *C. candiope*, *C. vologeses*, *M. leda*, *G. hottentota*, *R. libeon.*
	2. *A. phalantha*, *P. natalensis* ⊙ f., *E. dryope*, *H. perspicua*, *P. angolanus.*
S. djælælæ and *E. hiarbas.*	3. *N. saclava*, *Byblia* (*goetzius* ?), *Ypthima.*

M. leda was eaten in preference to *P. artaxia* and *P. antilope*, and *P. cebrene* to the latter. There is nothing to show whether the two rejected species were placed as low as *P. natalensis* or between it and *Melanitis.*

Adding now the less certain placings (those complicated by a possible raising of appetite), *H. perspicua* is placed above *P. natalensis* ⊙ f. though still below Grade 1, *C. brutus* and the blackish skipper are also placed above *P. natalensis* and perhaps in Grade 1, and *N. agatha*, *L. thalassina* ♀, and *P. hippocoon* are placed above *Neptis saclava.* A doubt naturally attaches to these placings.

Comment at the time.—"The bird seemed in excellent form and, an unusual thing for her, went on eating at 5-minute intervals after repletion-point had apparently been reached."]

Exp. 38.—*June* 8. Very hungry indeed and ate readily, after crushing each, *Nychitona medusa* and *Acræa serena* ♂, tasted and at once rejected *Acræa caldarena*, crushed and readily ate *Acræa asema*, tasted and rejected *Acræa doubledayi*, readily ate *Nychitona medusa*, tasted and rejected a very freshly emerged *Acræa serena* ♀ and a ♀ *Acræa caldarena* (the latter more emphatically), tasted and readily ate a more rubbed ♀ *Acræa serena* with, however, plenty of juice, tasted and at once rejected each of two rather rubbed *Acræa caldarena* ♂, and twice very thoroughly tasted and doubtfully rejected *Danaida chrysippus*, holding the insect each time longer in her bill and crushing it more thoroughly than the Acræas, being evidently tempted to swallow it. She ended each time in throwing it right away.

She then eagerly ate a *Charaxes candiope* and thereafter obstinately refused to touch a *Nychitona*, tasted and rejected a rubbed *Acræa serena* ♂, an *Acræa doubledayi* ♀, twice in succession a ♀ *Mylothris agathina*, subjecting it, however, to more prolonged tasting than any of the preceding insects, tasted and very promptly rejected a ♀ *Mylothris yulei* (with stronger smell), tasted well and threw away a second and different *Mylothris agathina* ♀, and after it a ♂, readily ate a *Belenois mesentina*, refused without tasting a *Terias senegalensis* with one wing, tasted and rejected it when disguised by the removal of the wing, and once more readily ate a *Belenois mesentina*, then tasted and rejected a rubbed *Acræa serena* and a ♀ *Acræa areca*, the latter with very marked signs of dislike.

An interruption of fifteen minutes now occurred while I experimented with the kingfisher. On my return the roller crushed and rejected *Terias senegalensis*, wingless, reoffered, but with the greatest apparent relish ate seven *Neptis saclava* in rapid succession.

I then gave ten grasshoppers, after which she readily ate a *Neptis goochi* and six *Neptis saclava* but threw away the seventh, then very readily ate a *Neptis agatha*, tasted and rejected *Neptis goochi* with very marked dislike, tasted and dropped but, on its being at once reoffered, once more tasted and this time swallowed readily *Neptis saclava*, again tasted and threw away with an emphatic shake of the head *Neptis goochi*, and once again quite readily accepted and ate a *Neptis saclava*, afterwards refusing without tasting a *Neptis goochi*.

She then ate one large and two small grasshoppers, and readily ate two *Neptis saclava*.

I then gave her six small grasshoppers. After eating these she tasted and rejected a *Neptis saclava* and then persistently refused it without tasting. Three minutes later I again offered it and it was again obstinately ignored, but the bird readily ate a *Hesperia* and a *Baoris*, tasted and threw away *Lampides bœtica*, but on its being reoffered tasted it well and swallowed it, then refused to touch a *Catochrysops dolorosa*, though she readily ate a ♀ *Papilio lyæus*, a ♀ *Leuceronia argia*, a *Henotesia perspicua*, a *Byblia*, and a *Neptis saclava*. There had been some slight delay between the last few offerings and the bird had once more become somewhat hungry [or appetite had come in eating].

She now ate five small scraps of meat and then, quite readily, *Precis cebrene* and *Neptis saclava*. On my now giving her two large pieces of meat (she refused the next), she refused persistently and repeatedly to have anything to do with *Neptis saclava*, but readily ate a *Melanitis leda* and a *Pyrameis*, also a *Henotesia perspicua*.

At this stage I gave her an enormous *Acridium lineatum*. This was battered and crushed and finally with difficulty swallowed. The bird now refused to touch *Neptis saclava*, readily ate *Precis cebrene*, refused without tasting *Eurytela dryope*, accepted *Leuceronia argia* ♀, held it for a long time in her bill, evidently not hungry, and finally swallowed it. She then refused, but changing her mind tasted *Precis natalensis* ⊙ f., and having done so, at once proceeded to crush and swallow it, refused without tasting a *Teracolus*, crushed and ate with relish an

Atella phalantha, accepted with disinclination but ate a *Precis cebrene*, refused without tasting a *Hamanumida dædalus*, took, held for a few seconds, and finally crushed and swallowed a *Precis cebrene*, refused without tasting a *Eurytela hiarbas*, accepted and ate a *Hamanumida dædalus*, and now, probably fairly replete, refused without tasting *Atella phalantha*, *Hamanumida dædalus*, and *Precis cebrene*.

Five minutes later she again refused these three, as also a small brown grasshopper, of which she is very fond.

Half an hour later she once more refused all four.

[SUMMARY, ETC. :—(1) I quote from my previous conclusions in this experiment:—

"The rejections of *Acræa caldarena*, *doubledayi*, and *areca* were very decided and emphatic, particularly the latter. On the other hand, all the *Acræa serena*, as also the *Acræa asema*, were subjected to rather more prolonged tasting. *Danaida* was evidently not distasteful in the same sense as the Acræas, but the bird, probably largely as the result of some past experience, was afraid to swallow it.

"In the second stage the bird tried each *Acræa* before rejecting it, but would not touch *Nychitona medusa*, which was evidently intensely disliked. It seemed probable, too, that the less nauseous Acræas come in acceptability almost up to the level of *Mylothris agathina*, which was itself less disliked to-day than *Mylothris yulei*. The latter had its peculiar smell strongly developed, none of the former had.

"*Henotesia perspicua* is evidently more palatable than *Neptis saclava*.

"*Prob. Order.*—1. *Precis natalensis* ⊙, *Atella phalantha*, *Hamanumida dædalus*, and *Junonia cebrene*, all eaten at the very end, are evidently exceedingly pleasant. To these might be added, *Leuceronia argia* ♀ (in preference to *Eurytela dryope*), which was once more accepted practically at repletion-point, though a *Teracolus* was refused, being confused perhaps with *Belenois*.

"2. *Henotesia perspicua.*
3. *Neptis agatha.*
4. *Neptis saclava.*
5. *Neptis goochi.*
6. *Belenois mesentina.*
7. *Terias senegalensis.*
8. *Mylothris agathina.*
9. (*Mylothris yulei*?)
10. *Acræa serena* and *asema.*
11. (*Nychitona*? and *Danaida chrysippus*?)
12. *Acræa doubledayi* and *Acræa caldarena.*
13. *Acræa areca.*"

(2) Revising, I would not go so far, although I have reason to know that the above list does represent the roller's usual preferences. The following list only, I think, can be really at all justified from the first section of the experiment and the other lists that I shall give from the remainder of it:—

(*a*) 1. *Belenois mesentina.*
T. senegalensis. { 2. *M. agathina* ♂ & ♀.
3. *Danaida chrysippus*, probably (on taste, not necessarily after-effect).
M. yulei ♀. { 4. *Nychitona medusa*, *Acræa asema*, *A. serena* (rubbed preferred to fresh).
5. *A. caldarena*, *A. doubledayi*, probably (on manner as against *A. serena*), *A. areca* ♀.

(β) 1. *N. agatha*, *Hesperia* sp., *M. leda*, *P. cebrene*, and probably *P. lycæus*, *A. phalantha*, *L. argia* ♀, and *P. natalensis* ⊙ f.
2. *N. saclava.*
3. *N. goochi*, *T. senegalensis.* } Probably *C. dolorosa* and possibly *L. bœtica.*

(γ) 1. *P. cebrene.*
2. *H. dædalus.* } *L. argia* ♀, *P. natalensis* ⊙ f., *A. phalantha.*
3. *Eurytela dryope* and probably *hiarbas* (latter, at any rate, below *dædalus*).

The bird's reconsiderations of *N. goochi* and *N. saclava* show how risky it would be in this experiment to include in the highest grades *Henotesia* and the other insects the acceptance of which might have been the result of special stimulation.]

Exp. 39.—*June* 9. Very hungry after a fast of several hours. Tasted and rejected *Danaida chrysippus*, *Amauris lobengula*, and *Acræa areca*, and refused without tasting *Acræa caldarena*, *Acræa serena*, and *Acræa cabira*. I next offered *Mylothris agathina* (a gravid ♂), with unusually strong menthol scent. It was crushed and readily eaten, and *Acræa cabira* was then crushed and readily swallowed, as also a ♂ *Acræa serena*, rather rubbed. *Acræa caldarena* ♂ was crushed and at once rejected, a white *Acræa esebria* was thoroughly tasted and swallowed, an *Acræa doubledayi* was tasted and rejected, as was also *Acræa natalica*. *Nyctemera leuconoë* ♀ was now readily eaten, a buff *Acræa esebria* tasted and swallowed after momentary hesitation, a freshly-emerged *Acræa serena* crushed and eaten, but *Acræa areca* ♂ rejected with intense disgust. Another fresh-looking *Acræa serena* was crushed and eaten, but *Danaida chrysippus* and *Amauris lobengula* tasted and rejected.

Five minutes later the bird was sitting with feathers ruffled, possibly suffering some discomfort from the *Acræas* eaten, possibly not. She tasted and rejected a bright-looking *Acræa serena* and a black-and-red *Acræa esebria* ♀ (gravid), crushed and readily ate *Mylothris agathina* ♂ (with a decided smell, less strong, however, than that of the ♀ accepted earlier), tasted and rejected *Acræa serena* and black-and-red *Acræa esebria*, refused obstinately without tasting *Nychitona medusa*, but tasted and readily ate *Nyctemera leuconoë* ♀ and a *Terias* (*brigitta* ?).

After a short interval she refused without tasting *Acræa serena*, crushed well and ate *Acræa esebria* (red-and-black ♀), refused without tasting *Acræa serena*, tasted and rejected emphatically *Nychitona medusa*, tasted very thoroughly and ended by rejecting an *Acræa serena*, disguised slightly (to secure its tasting) by being offered with a forewing instead of the usual hindwing, ate a few grasshoppers, then tasted and rejected *Belenois mesentina* and *Terias desjardinsii* (?), ate a few more grasshoppers, refused without tasting *Neptis saclava*, *Neptis goochi*, a *Byblia*, and a *Hamanumida dædalus*, but evidently recognized and at once stretched out eagerly for a *Catacroptera cloantha*, which she ate with apparent relish. She then accepted, crushed, and readily ate *Hamanumida dædalus*, *Atella phalantha*, and a *Byblia* (dark hindwing, no trace of smell), twice tasted cautiously and rejected a *Teracolus*, tasted and threw right away a *Neptis saclava*, and then refused without tasting but shortly afterwards accepted and ate a *Henotesia perspicua*.

[Summary, etc.:—1. *Note at the time.* "The *Catacroptera* was evidently very greatly liked. *Henotesia perspicua* was liked better than *Neptis saclava* and the *Teracolus.*

"The *Acræa areca* was discarded with a greater show of disgust than either Danaine, probably simply because the bird got a good dose of the bitter fluid in her bill.

"*Acræa natalica*—a rubbed specimen and probably without a great store of liquid (it was exuding some, however)—was rejected promptly, but without special fuss, treated, in fact, like *Acræa caldarena* and *doubledayi.* There could be no doubt as to these two being very decidedly more distasteful than even fresh *Acræa serena.* I had also little doubt, taking the bird's manner as an indication, that the latter was less liked than *Acræa esebria* and still less, probably, than *Acræa cabira. Nyctemera* and *Mylothris agathina* (an unusually strong-smelling ♀) were less objected to than any of the above. *Nychitona* I believe to come between *Acræa caldarena* and *Acræa serena* (*cf.*, too, yesterday's experiment). The *Amauris lobengula* had an unusually slight smell, the ♂ *Mylothris* about the average smell for a ♂ of this species. All the *Danaida* used to-day had just the average amount of smell. None of them was quite without, but none possessed the just distinguishable *Amauris* smell that one occasionally finds in this species. All the butterflies used, except *Nychitona*, had been captured by myself, so that the rubbed condition of the wings was, when present, due to natural wear and tear and not to native handling."

2. *Order of preference*:—

(α) 1. *M. agathina* ♂ & ♀, *N. leuconoë*, *Terias.*
2. *A. esebria.* } *A. cabira.*
3. *A. serena.* }
N. medusa. }
D. chrysippus. } 4. *A. caldarena*, *A. doubledayi*, *A. natalica* (rubbed).
A. lobengula. } 5. *A. areca.*

(β) 1. *C. cloantha.*
2. *N. saclava*, *N. goochi*, *Byblia*, *H. dædalus*, *B. mesentina*, *T. desjardinsii*, *A. esebria*, &c., &c.

(γ) 1. *H. perspicua.*
2. *N. saclava* and *Teracolus.*]

Exp. 40.—*June* 10. Very hungry indeed—12 noon, and except for termites had received nothing since 6 P.M. last night.

Tasted and rejected *Danaida chrysippus* and *Amauris lobengula* (without very much smell: the *Danaida* was normal in this respect), tasted and at once rejected a fresh-looking *Acræa caldarena*, crushed and readily ate *Acræa serena*, crushed and rejected with special disgust *Acræa* sp. inc., crushed thoroughly, holding it for some time as she did so, an *Acræa doubledayi* ♂, probably not very lately emerged, and finally rejected it.

Half an hour later, no food meantime, she crushed and readily ate a ♀ *Danaida chrysippus*, tasted and rejected with disgust a strongly-smelling *Amauris lobengula*, just captured, crushed and ate without hesitation a ♂ *Danaida chrysippus*, refused with shakes of the head but finally tasted well and rejected with marked dislike a second freshly-captured *Amauris lobengula* with decided smell, afterwards shaking her head violently, tasted and rejected in turn *Acræa doubledayi* ♂, *Acræa natalica*, and *Acræa* sp. inc., also *Acræa serena*, but ate after crushing it, with apparently the greatest readiness, *Danaida chrysippus.*

Half an hour later she tasted and rejected *Acræa doubledayi* ♂, *Acræa natalica*, and *Acræa* sp. inc., refused with what looked like horror *Danaida chrysippus* but finally cautiously tasted and rejected it, refused *Amauris lobengula* but then accepted, crushed and dashed it away with the greatest show of disgust.

I twice during the next thirty or forty minutes, no food meantime, offered again the *Danaida chrysippus*, and it was each time obstinately refused without tasting, as it also was late in the afternoon after a further period of starvation. *Amauris lobengula* was similarly treated.

[SUMMARY, ETC.:—1. *Note at the time.* "I purposely carried out this *Danaida* experiment on the roller and kingfisher on much the same lines, and the results were very similar in each case to those obtained already from other birds.

"*Danaida* here, as there, appeared to be not only less obviously unpleasant than *Amauris* but even perhaps than any *Acræa*, but its after-effects, if eaten out of place, are quite probably villainous, whether worse than those of *Amauris* it is impossible to say, but it was refused even after a further period of starvation. *Amauris* was detested by both birds, and in point of obvious unpleasantness is quite likely as bad as even *Acræa areca.*"

2. *Order indicated* :—

1. *D. chrysippus* and *A. serena* (each, at different times, eaten in preference to the other).
2. *A. doubledayi* ♂, "without a good supply of fluid."
3. *A. caldarena*, "fresh ♂, rejected with greater decision than" 2.
4. *A. areca*, highly spotted, "rejected with greater fuss than" 3, "*A. lobengula*."]

Exp. 41.—*June* 12. Had fed well on grasshoppers, &c., and retired once more to her perch. I gave her a very large wood-boring larva, probably that of *Anthores leuconotus*, equal in weight to perhaps four *Charaxes*. It was run several times through her bill and swallowed with apparent relish.

She then refused without tasting a *Terias* and a *Neptis saclava*, but readily accepted, crushed, and swallowed a *Hamanumida dædalus*, tasted and rejected a *Mycalesis campina* with evident dislike, readily ate after crushing them a *Leuceronia* and a *Papilio lyæus*, hesitated to accept but after tasting readily swallowed a *Henotesia perspicua*, crushed and readily ate a ♂ *Phrissura isokani*, tasted well and rejected a dark-coloured *Byblia*, refused obstinately with shakes of the head a *Mycalesis campina*, but ate with evident relish a *Precis natalensis* ⊙ f., ate readily a second big longicorn larva, crushed and tossed away *Leuceronia argia* ♂, refused without tasting *Papilio dardanus* ♂, readily ate after crushing it *Precis clelia*, refused without tasting *Leuceronia argia*, but crushed and ate with apparent enjoyment *Precis archesia* and *Precis natalensis* ⊙ f., refused without tasting *Leuceronia argia*, *Papilio dardanus* ♂, and *Eurytela dryope*, but crushed and readily ate a *Charaxes neanthes*, a *Melanitis leda*, and a *Rhopalocampta libeon* (no smell), also a *Charaxes vologeses*, the latter after a little delay, the bird being no longer hungry. She then merely played with *Charaxes pollux*, repeatedly tossing it up and catching it again and ended by dropping it, afterwards refusing *Pyrameis cardui* and *Precis cebrene*.

Ten minutes later she crushed and tossed away a ♀ *Leuceronia argia*, crushed similarly and threw right away a *Papilio dardanus* ♂, and accepted the previously-offered *Charaxes pollux* and a *Melanitis leda*, playing with each for a few seconds before finally swallowing it. She then refused without tasting, but on its being reoffered accepted, crushed, and tossed aside a *Rhopalocampta libeon* (no smell) and refused without tasting *Eurytela dryope*, *Byblia* (the dark individual previously rejected), *Pyrameis cardui*, and *Precis cebrene*.

Five minutes later she tasted and rejected *Papilio dardanus* ♂, readily ate a *Pyrameis cardui*, tasted well and rejected a light-coloured *Byblia*, crushed and readily ate a *Hamanumida dædalus* and a *Melanitis leda*, tasted and rejected a (forest?) *Mycalesis campina*, also *Henotesia*, tasted and readily ate *Precis cebrene*, *Precis elgiva*, and two *Charaxes neanthes*, then played with and finally swallowed a *Charaxes achæmenes*.

I was here interrupted for some minutes. On my return I offered *Precis natalensis* ⊙ f., which was readily eaten, but the bird had evidently become hungrier, for she now crushed and at once swallowed the *Leuceronia argia* ♀ already rejected and a *Papilio lyæus*.

I now gave her two *Charaxes brutus*, after which she refused without tasting a *Leuceronia thalassina* ♀, tasted and rejected *Neptis agatha*, but accepted, crushed well, and swallowed a *Rhopalocampta libeon* with a slight Pentatomid-like smell.

[SUMMARY:—Placing in Grade 1 not only the species for which a special preference as against the next grade was shown but also those eaten or dallied with close to apparent repletion-point, we have:—

1. *R. libeon*, *C. vologeses*, *C. pollux*, *M. leda*, *C. neanthes*, *C. achæmenes*, *P. clelia*, *P. archesia*, *P. cebrene* (perhaps *P. natalensis*, *P. cardui*, *H. dædalus*).
2. *Leuceronia argia* and *thalassina*.
3. *Terias*, *N. saclava*, *M. campina*, and probably *Byblia*.

} *P. dardanus*, *E. dryope*, *N. agatha*.

P. lyæus, *H. perspicua*, and *P. elgiva* might all be inserted above Grade 3 were it not for the possibility that they were eaten after special stimulation.]

Exp. 42.—*June* 14. Moderately hungry; refused without tasting *Danaida chrysippus*, *Acræa caldarena*, and *Acræa serena*, and a few minutes later tasted and rejected *Acræa asema*, ate readily *Mylothris agathina* ♂ and *Nyctemera leuconoë*, but tasted and rejected a small *Acræa* (*doubledayi*?).

Twenty minutes later she tasted and rejected a wingless *Danaida*, refused without tasting *Acræa caldarena* and *Acræa serena*, but at once distinguished *Byblia* from the latter, seizing, crushing, and swallowing it.

[SUMMARY :—

1. *M. agathina* ♂, *N. leuconoë*, and *Byblia.*
2. *D. chrysippus, A. caldarena, A. serena.*

1. *M. agathina* ♂ and *N. leuconoë.*
2. *A. asema.*]

Exp. 43.—*June* 15. Very hungry after unusually long period without food; refused persistently without tasting *Danaida chrysippus*, *Acræa serena*, *Acræa doubledayi*, and *Acræa caldarena.* A testimony to the low grade of these butterflies.

Exp. 44.—*June* 17. Very hungry, several hours without food; refused without tasting *Acræa asema.* A testimony to the butterfly's low grade.

Exp. 45.—*June* 19. Slightly hungry, readily ate a migratory locust, refused persistently without tasting a *Terias*, readily accepted and ate a *Neptis agatha*, tasted and rejected but, on its being reoffered, ate an *Ypthima* and after it, without eagerness but without special hesitation, a second.

I then gave her one large and four small grasshoppers, equivalent in all to, perhaps, four large *Charaxes.* They were slowly eaten, the bird being evidently no longer hungry.

She then tasted and rejected *Papilio dardanus* ♂, tossing it away, refused without tasting *Papilio dardanus* ♀ f. *hippocoon,* accepted, played with, and dropped *Charaxes achæmenes*, but crushed and ate it readily enough on my now reoffering it; tasted very thoroughly and then readily swallowed the pupa of *Pyrameis cardui*, pupated May 27; refused without tasting a rather dark *Byblia* and *Precis natalensis* ⊙ f., then accepted and ate, though without special appetite, *Pyrameis cardui* and *Precis cebrene*, crushed very thoroughly and tossed aside *Precis natalensis* ⊙ f., crushed and readily ate *Precis clelia*, tasted slightly and rejected *Lampides bœtica.*

Five minutes later she again tasted and dropped *Precis natalensis* ⊙ f.

Five minutes later again she crushed it well and swallowed it with no sign of dislike, refused obstinately without tasting *Lampides bœtica*, *Ypthima*, and *Papilio dardanus* ♂, but readily ate a *Precis cebrene.*

[SUMMARY :—

(a) *N. agatha* . . . . { 1. *P. cebrene.*
{ 2. *Ypthima.*
P. dardanus ♂ and *L. bœtica.* { 3. *Terias.*

(b) 1. *P. cardui*, *P. clelia*, *C. achæmenes.*
2. *P. dardanus* ♂ & ♀.

(c) 1. *P. cardui* and *P. clelia.*
2. *P. natalensis* ⊙ f. and *Byblia.*

P. natalensis ⊙ f. probably only very slightly below "1" of (*c*).

P. cardui's 23rd day pupa not certainly in Grade 1 of (*b*) but, if not, probably near it.]

Exp. 46.—*June* 21. Hungry; crushed and ate a *Terias* (brown underside), refused obstinately without tasting and with shakes of the head *Acræa serena*, tasted and rejected *Mylothris agathina*, crushed very thoroughly, evidently wavering, and finally threw away a *Terias* of the same species.

She then readily ate five good-sized grasshoppers, refused without tasting an *Ypthima*, but on my reoffering it tasted it well and rejected it. She then refused without tasting a rather rubbed *Neptis saclava*, recognized and eagerly seized and ate a *Pyrameis cardui*, afterwards accepting, crushing, and eating without hesitation a *Neptis agatha*. On my now again offering an *Ypthima* the bird refused it without tasting, shaking her head vigorously and finally striking it out of the forceps with the side of her bill. She then, however, readily accepted and ate the *Neptis saclava*.

I then gave her a large number of grasshoppers—fed her, in fact, till she obstinately refused to eat any more, even of her apparent favourites. Nevertheless, she now readily accepted and ate not only *Hamanumida dædalus* but a *Leuceronia*, afterwards eating a *Precis cebrene* but refusing without tasting a *Neptis agatha*. On my now pressing this on her, she tasted and rejected it, refused obstinately without tasting a skipper and *Lampides bætica*, but readily ate a *Pyrameis cardui*.

I now gave her three *Charaxes brutus* and two *Charaxes candiope*. She ate them with increasing slowness and held the last *candiope* for a long time in her bill before finally swallowing it; quite evidently she was almost replete. I now offered a brown *Crenis*. She at first refused it without tasting, but on my continuing to proffer it she accepted, crushed, and ate with evident liking not only it but a *Precis antilope* ⊙ f. and a *Precis madagascariensis*.

The roller now accepted and with marked disinclination and after prolonged crushing ate a *Charaxes brutus*, held for some time a *Charaxes candiope* and after it a *Charaxes ethalion* as though loath to drop such tit-bits but too full to eat them, and finally did crush and eat each. A *Precis madagascariensis* was then more quickly crushed and eaten, and after an interval of three or four minutes a *Charaxes vologeses* was well crushed and swallowed. It was evident, however, that the bird had difficulty in getting it down, and a *Charaxes brutus* was now persistently refused without tasting.

[Summary :—

1. *P. cardui, H. dædalus.*

N. agatha, Skipper, *L. bætica*. {
2. *N. saclava*, favourite grasshoppers.
3. *Ypthima* and *T. brigitta*.
4. *M. agathina*: this *possibly*, on manner, above.
5. *A. serena*.

The *Leuceronia*, *P. cebrene*, and *N. agatha* might also be placed above *N. saclava* and the *Crenis*, *C. ethalion*, and *P. antilope* go into Grade 1 were it not for the possibility that their eating was the result of special stimulation. The butterflies eaten right *at* obvious repletion-point (*C. brutus*, *C. candiope*, *C. vologeses*, and *P. madagascariensis*) may, I think, in spite of a similar objection, be placed with some confidence in Grade 1. The low placing of favourite grasshoppers was probably—as in nearly every experiment—the result of having eaten so many. Had better flies been used for "filling up," it is probable that the favourite grasshoppers would have been taken in preference to the favourite butterflies.]

Exp. 47.—*June* 22. Early in the day, before being fed, very hungry, had refused without tasting *Acræa serena* and *Acræa asema*, also *Danaida chrysippus*—a testimony to their very low grade.

She now, considerably less hungry, refused without tasting and with shakes of the head *Acræa serena*; refused, then tasted very slightly and with the greatest weariness and threw aside a *Danaida chrysippus*, refused without tasting a *Terias*, but tasted and readily ate an *Ypthima*.

I now gave her three migratory locusts, after which she obstinately refused to touch either *Lampides bœtica* or an *Ypthima*. I therefore gave her an enormous mixed feed of migratory locusts, various grasshoppers, crickets, etc., and termites, and when she was thoroughly replete and would touch no more of any of them I offered her a *Charaxes neanthes*. Either through sheer repletion or from suspicion of the fulvous wing-colour (reminiscent of *Atella*?) she would not touch it, but a few seconds later was tempted by a *Pyrameis*, which she ate. I then offered *Precis ceryne* ⊙ f. The bird at first refused it, but as I continued to hold it to her, tasted it slightly and, evidently attracted, took it, crushed it thoroughly and swallowed it. and directly after tasted well and readily swallowed a *Charaxes neanthes*. I now offered an *Ypthima* which she took and tasted, but at once threw away with marked dislike, wiping her bill vigorously on the perch.

[SUMMARY:—

1. *P. cardui* (possibly *P. ceryne* and *C. neanthes*).
2. Favourite grasshoppers, crickets, migratory locusts, termites, and *C. neanthes* (or *A. phalantha* if the *neanthes* was mistaken for this).

L. bœtica. {
3. *Ypthima.*
4. *Terias, A. serena, A. asema, D. chrysippus.*]

Exp. 48.—*June* 23. Hungry; refused obstinately without tasting *Acræa serena*; refused, then tasted in a very gingerly way and rejected *Mylothris rueppelli* and *Mylothris yulei*; tasted rather better, then rejected *Nyctemera leuconoë*.

[Possibly, on manner, we get:—

1. *N. leuconoë.*
2. *M. rueppelli* and *yulei*.
3. *A. serena.*

But this is, at best, doubtful. At any rate, all were obviously very low-grade.]

Exp. 49.—*June* 24. Moderately hungry at the start. I gave her all the meat she would eat (two smallish lumps) and then by hand a number of various grasshoppers until she at last obstinately refused to touch any more. I waited five minutes and again offered grasshoppers, but the bird held the first in its bill a considerable time before swallowing it and then refused all others. I next offered a *Neptis saclava.* This was refused without tasting with shakes of the head, but a *Pyrameis* was accepted and eaten, a small *Sarangesa* was refused persistently without tasting, and an *Ypthima* tasted and at once emphatically rejected with much head-shaking. The bird then tasted and at once rejected a dark *Byblia* without, however, marked signs of dislike, crushed very thoroughly *Leuceronia thalassina* ♂ and ended by rejecting it, again crushing and rejecting it on its being reoffered; refused without tasting *Pinacopteryx pigea*, ate, though obviously without appetite, *Pyrameis cardui* and *Precis cebrene*, tasted slightly and threw away a *Lampides bœtica*, crushed a small *Hesperia* in the point of her bill and dropped it (it had, like *Rhopalocampta*, a bug-like smell), and then refused a *Pyrameis*, though I did my level best to coax her into taking it. There could be no doubt of her repletion. I now offered *Salamis anacardii* with forewing attached. The bird at first hesitated, then bent forward, tasted and, obviously liking it immensely, crushed it up and swallowed it. The large wing caused a little delay by sticking in the gullet, but after one or two efforts it was completely swallowed, the bird all the time showing no sign of any feeling other than relish. She now listlessly took and dropped a *Pyrameis cardui*, but ate it on its being reoffered and persistently refused the next.

Ten minutes later she refused without tasting a *Mycalesis*, *Melanitis leda*, and a *Leuceronia thalassina.*

[Summary :—

1. *Salamis anacardii.*
2. *P. cardui* (*L. bœtica* and the *Hesperia* here or lower).
3. *L. thalassina* ♂.
4. Grasshoppers.
5. Meat (sp. ?).

N. saclava, *Ypthima*, and *Byblia* (also the *Sarangesa* and *Pinacopteryx*, if these were not mistaken, as is likely, for something else).]

Exp. 50.—*June* 25. Hungry; refused but, changing her mind, crushed very thoroughly, played with by throwing it up into the air and catching it again several times, *Mylothris agathina* ♀ with scent of medium strength, and ended by throwing it away.

She now refused without tasting both it and *Mylothris yulei*, but accepted readily, crushed and swallowed a *Belenois severina*, and refused without tasting but, on my continuing to proffer it, took, tasted and threw away a *Terias.*

I now gave her four medium-sized grasshoppers, after which she persistently refused *Neptis goochi*, tasted slightly and rejected *Neptis saclava*, refused without tasting a dark *Byblia*, but readily accepted and ate a *Precis cebrene.* She now tasted the *Byblia* and rejected it with unmistakable dislike and obstinately refused to touch a small *Pinacopteryx*, with orange base to forewings. She tasted, however, and readily ate a ♀ *Leuceronia argia*, but again refused the *Pinacopteryx* (front wing attached), mistaking it probably for a *Mylothris yulei.* After this she tasted but at once rejected a *Phrissura isokani*, and refused but tasted and then readily ate a *Lampides bœtica.*

Fifteen minutes later (no food meantime) she tasted very thoroughly and ate a large *Mycalesis,* refused for some time but finally tasted and swallowed a *Henotesia perspicua*, again refused but eventually tasted and ate an *Ypthima.* But she refused persistently to have anything to do with the next, tasted and rejected *Neptis saclava*, refused without tasting but finally tasted and pitched away an *Ypthima*, and obstinately refused the next without tasting. She now refused without tasting two small *Pinacopteryx* (one white, the other orange-based).

Ten minutes later she accepted the white *Pinacopteryx* (small), crushed it very thoroughly and rejected it, but readily ate *Neptis saclava*, then refused persistently and emphatically with shakes of the head a *Terias*. *Phrissura isokani* ♂, wingless, was now tasted and rejected.

[SUMMARY, ETC. :—(1) *Note at the time*: " The bird was distinctly suspicious of the small dark brown *Henotesia perspicua*, no doubt confusing it with *Mycalesis campina* and *Ypthima*. Immediately afterwards she was reassured (or so it appeared) by the comparative palatability of the *Henotesia* (or else appetized by it) into eating what she had probably wished to avoid—*Ypthima* itself."

(2) *Grades* :—

(*a*) 1. *L. bœtica*, *L. argia*, and probably *P. cebrene*.
2. *N. saclava*. } *Byblia*, *P. isokani*, *N. goochi*.
3. *Pinacopteryx* sp. }

(*b*) 1. *Belenois severina*.
2. *M. agathina* ♀, *M. yulei*, *Terias*.]

Exp. 51.—*June* 26. To place *Pseudacrœa trimeni*. I found the roller hungry and gave her a full feed of meat, various grasshoppers, and a large beetle-grub, followed by more grasshoppers. She finally refused to touch anything more. Five minutes later she consented to eat two more small grasshoppers but with complete disinclination, and refused to touch another, though various species were offered. She now refused without tasting a *Precis cebrene*, tasted very slightly and dropped *Tagiades flesus*, crushed well and, after a little delay, the result of repletion, ate a *Pyrameis*, crushed and readily ate a *Macroglossa trochilus*, evidently liking it. She now ate, though again with disinclination, two grasshoppers of a very favourite species (previously refused) and after them readily enough another *Pyrameis*. She now refused without tasting a *Pseudacrœa trimeni* with, as usual, one wing attached, but, tempted by its violent movements, accepted it, crushed its thorax thrice, and then dropped it. She then refused without tasting *Papilio lyœus* ♀, *Neptis saclava*, and *Precis cebrene*, and crushed very slightly and dropped *Pyrameis cardui*.

The *Pseudacrœa* was still alive, but unlikely to survive its injuries for long.

Ten minutes later the bird crushed and dropped a *Pyrameis*, and refused without tasting a *Gegenes*.

Ten minutes later she again crushed and dropped a *Pyrameis*, but on my reoffering it ate it readily enough, refusing, however, without tasting a *Precis cebrene* and a *Pseudacrœa trimeni*.

Fifteen minutes later she readily accepted and ate *Hamanumida dædalus*, obviously recognizing it, persistently refused a ♂ *Leuceronia thalassina*, and then refused but, suddenly changing her mind, accepted and readily ate a *Precis cebrene*. She now refused without tasting *Pseudacræa trimeni*, tasted and rejected *Tagiades flesus*, and refused with many shakes of the head *Neptis saclava* and a *Mycalesis campina*, as also with less demonstration *Leuceronia thalassina* ♂, *Papilio lyæus* ♀, and *Pseudacræa trimeni* ♀.

[Summary :—

1. *P. cardui* (*Macroglossa trochilus* less certainly here).
2. *P. cebrene*. } *Tagiades flesus*.
3. *L. thalassina* ♂.
4. *N. saclava* and *M. campina* refused with more demonstration than *L. thalassina* ♂, *P. lyæus* ♀, and *Pseudacræa trimeni* ♀, but it would be unsafe to rely too much on this.]

Exp. 52.—*June* 27. To place *Pseudacræa trimeni*. Had retired to her perch after a big feed of various grasshoppers, termites, &c.; replete. She refused, then leant forward, tasted and rejected in turn *Neptis saclava* and *Neptis agatha*, refused absolutely without tasting *Phrissura isokani*, *Mycalesis campina*, and *Henotesia perspicua*, but fairly readily accepted and ate a *Pyrameis*. She now crushed well and threw away a *Leuceronia thalassina* ♂ and again ate a *Pyrameis*, crushed well and tossed away a *Papilio lyæus* ♀, and once more, though with disinclination, ate a *Pyrameis*. She then twice, with a short interval between, refused with shakes of the head yesterday's *Pseudacræa trimeni* ♀, which was still alive; refused but, on tasting, changed her mind and with a surprising show of relish, considering her treatment of the other pleasanter species, ate two *Precis natalensis* ⊙ f., the second without the slightest hesitation in acceptance. She now refused a *Pyrameis* without tasting, crushed and ate with an air of disinclination a *Precis cebrene*, and then readily ate a *Precis natalensis* ⊙ f. The next *Precis cebrene* was refused persistently without tasting.

Fifteen minutes later she refused without tasting *Papilio lyæus*, *Leuceronia thalassina*, and *Pseudacræa trimeni*, readily ate a *Pyrameis* and refused without tasting *Neptis saclava*.

[Summary :—(1) *Grades* :—

1. *P. cebrene*.
2. *P. cardui* and probably *P. natalensis* ⊙ f. (I draw no inference, however, from its last acceptance as this immediately succeeded that of a *P. cebrene*).
3. *L. thalassina* ♂, *P. lyæus* ♀, *Ps. trimeni*, *N. saclava*, *N. agatha*, *P. isokani*, *M. campina*, and, if not through mistake (as it probably was), *H. perpicua*.

(2) *Note at the time*: "The *Leuceronia* was practically killed by its tasting, the *Papilio lyæus* not, but it was disabled and would certainly not recover from its injuries."]

Exp. 53.—To place *Pseudacræa.* Later in the day, the bird being once more somewhat hungry, I gave it four grasshoppers and a *Neptis saclava*, all of which were readily eaten. After five more small grasshoppers, she obstinately refused without tasting *Ypthima*, *Neptis saclava*, and *Neptis agatha*, but evidently not recognizing as a *Neptis* a *Neptis swynnertoni*, which I now offered with all its wings, at once seized on it, but on tasting it threw it hastily away. She now ate a small grasshopper, tasted and rejected in turn *Pseudacræa lucretia*, *Papilio lyæus*, and *Pseudacræa trimeni*, readily accepted and ate *Precis cebrene*, refused a *Precis natalensis* ⊙, but then, as though struck by an idea, suddenly leant forward, tasted it cautiously, and at once crushed and swallowed it.

After a considerable interval to allow her to become hungry once more (for the rejection of *Papilio lyæus* had shown her to be too nearly replete), I again offered *Neptis saclava.* It was refused without tasting, but a ♂ *Leuceronia thalassina* was well crushed and readily eaten, the *Pseudacræa trimeni* was refused without tasting, a *Henotesia perspicua* was well tasted and thrown away, and a *Mycalesis campina* was refused without tasting.

The bird now at first refused, but, changing her mind, tasted, crushed, and at once swallowed *Neptis agatha*, and then, with a great shake of her feathers, roused herself from her previous listless condition and, buckling energetically to the fray, crushed and ate in quick succession *Neptis saclava*, *Ypthima*, *Henotesia perspicua*, *Mycalesis campina*, and *Belenois mesentina*, but rejected with marked disgust *Mylothris agathina* and *Mylothris yulei.*

[Summary, etc. :—(1) *Note at the time* : "The chief new result was the unacceptability of *Neptis swynnertoni.* The butterfly was to all appearance undamaged by its tasting and continued to move freely about the cage."

(2) *Grades* :—

(*a*) 1. Grasshopper, *P. cebrene*, and *P. natalensis* ⊙ f.
2. *N. saclava*, *N. agatha*, *N. swynnertoni*, *P. lucretia*, *P. trimeni*, *P. lyæus*, *Ypthima.*
(*b*) 1. *L. thalassina* ♂.
2. *N. saclava.*

The eating of *L. thalassina* failed to procure that of *P. trimeni*, and it is just possible therefrom that the *Pseudacræa* is not as high as *Leuceronia* ; similarly, *M. agathina* pulled the roller up when she got "on the run" just afterwards, and *Mycalesis*, *Belenois*, &c., which failed to do so, were quite likely therefore less unpleasant than the *Mylothris.*]

Exp. 54.—*June* 28. To place *Pseudacræa.* Crushed and rejected with utter disgust the larva of *Acræa serena*, ate steadily after tasting it a ♂ *Phrissura isokani*, refused a ♂ *Mylothris agathina* (smelling strongly of sweet-brier) with shakes of the head, and tasted and at once threw away *Mylothris yulei.* A second *Phrissura isokani* was readily accepted, crushed, and swallowed.

I now offered a very large moth (*Nyctipao macrops*), with only two wings removed ; the bird readily ate it, and then persistently refused to touch *Neptis saclava.* She accepted, however, crushed and tasted well, and swallowed *Neptis* *swynnertoni*, again refused without tasting, most obstinately, *Neptis saclava*, tasted and crushed very thoroughly and swallowed *Papilio lyæus*, then refused but, on my continuing to hold it to her, tasted slightly and dropped *Pseudacræa trimeni*.

After a short interval she refused without tasting *Mylothris yulei* and *Mylothris agathina*, readily ate a *Charaxes brutus* with one wing, refused for a time quite decidedly *Neptis agatha* and *Neptis saclava*, but ate readily after thorough crushing *Pseudacræa lucretia*, *Ypthima*, and a second *Neptis agatha*, this one with all wings attached; then the *Neptis saclava*. "Appetite"—for butterflies of this category—"had evidently come in the eating" of the *Pseudacræa* (*cf.* yesterday's experiment).

She now ate a second but this time wingless *Charaxes brutus*, and tasted warily and emphatically threw away an *Ypthima*. I had only a dead and completely dried-up *Neptis* left (*Neptis saclava*), but, wishing to see whether it would be refused without tasting, offered it. The bird at once freely accepted it, thereby showing once more, I thought, that it preferred it to *Ypthima*, but, finding it doubtless to be dry and unattractive, pitched it right away.

[SUMMARY :—

(*a*) 1. *C. brutus*, *P. isokani*, *N. macrops*, *N. swynnertoni*, and *P. lyæus*.
    2. *M. yulei* and *M. agathina*, larva of *A. serena*.
(*b*) 1. *N. swynnertoni*, *P. lyæus*, and *Ps. lucretia* apparently above
    2. *N. saclava* (and *P. lucretia* above *N. agatha*).
    3. (On manner) *Ypthima*.

As my object had been to compare *Pseudacræa trimeni* with *N. saclava* or *P. lucretia* (I had previously "placed" these two in the same grade) and I had none left, I discontinued. During the next two hours I was fortunate enough to secure both *N. saclava* and *P. lucretia*, and on my return, the *P. trimeni* being still alive, resumed the experiment.]

Exp. 55.—To place *Pseudacræa*. The roller had become fairly hungry in the interval, but tasted and rejected with the greatest promptness a larva of *Acræa serena* and refused *Mylothris yulei* without tasting. She now ate four small grasshoppers, and after them an *Ypthima*. She had evidently not quite reached the desired stage. A *Charaxes brutus* however carried her just too far, for she now obstinately refused without tasting a *Neptis saclava* and a second *Ypthima*. I therefore waited five minutes, when a *Henotesia perspicua* was also refused without tasting. Three minutes later the bird refused a *Neptis saclava* but tasted well and readily ate a *Eurytela dryope*.

Three minutes later again she crushed and as readily ate a *Neptis saclava*, refused an *Ypthima* most obstinately without trial, tasted and dropped a second *Neptis saclava*, evidently more ready to consider it, tasted very thoroughly and dropped both *Pseudacræa trimeni* and *Pseudacræa lucretia*, thus indicating that *neither* was *more* acceptable to her than the *Neptis*, tasted and at once rejected a *Byblia*, refusing to touch a second; refused but then, wavering, tasted and, evidently reassured, at once ate *Eurytela hiarbas* and after it, after thorough crushing, a *Papilio lyæus* ♀.

The bird had quite evidently just before arrived at the stage of wavering whether to accept *Neptis saclava* and its like or to reject them, but the *Papilio* had once more carried her on too far, for even ten minutes later she refused without tasting *Pseudacræa lucretia*; then barely tasted if at all *Pseudacræa trimeni* and refused to take it from the forceps, leant forward to take a *Neptis saclava* but thinking better of it at the last moment withdrew without having actually tasted it. The decisive moment was evidently however very near at hand, so giving the bird another two minutes—all I dared to risk—I offered the *Byblia*. She tasted it and then went on to crush it well and eat it, refused with a shake of the head, then, relenting, accepted, crushed very thoroughly and swallowed *Pseudacræa trimeni*, similarly refused *Pseudacræa lucretia*, but again relenting, tried it, crushed it thoroughly, and swallowed it. She next refused *Neptis saclava* too, but, changing her mind once more, tasted it very thoroughly indeed and finally flung it away; refused but, on tasting, ate without further hesitation a blackish skipper, after it tasting very thoroughly and eating with equal readiness a *Baoris*. She then tasted well and swallowed the *Neptis* which she had just rejected, and readily ate a *Gegenes*.

[SUMMARY, ETC.:—(1) *Note at the time*: "The difficulty of satisfactorily placing a butterfly of which one possesses only a single example is well illustrated by these experiments on *Pseudacræa trimeni*. It was not until late in the fifth experiment that I was at last successful, but the decisive and unequivocal nature of the result then obtained would have amply repaid a greater amount of trouble. I had before suspected, chiefly from the behaviour of the shrike, that *Pseudacræa trimeni* was decidedly pleasanter than *Pseudacræa lucretia*, but no doubt could possibly remain in the mind of anyone witnessing this concluding experiment that to the roller there is not a particle of difference between them in this respect, and that that between the *Pseudacræas* and *Neptis saclava* is, if it exists at all, infinitesimal. I had the good fortune to bring the bird twice to the exact point at which she wavers over *Neptis* and other butterflies of the same calibre. On the first of these occasions she showed unmistakably that neither *Pseudacræa* is *more* acceptable than *Neptis saclava*, on the second that neither is *less* acceptable. The fact of having just eaten the two large Pseudacræas would be sufficient to alter to a trifling extent the state of its appetite and to secure the rejection of the not more unpalatable *Neptis*, which was otherwise treated exactly similarly and in any case eaten [after stimulation] immediately afterwards.

The *Pseudacræa trimeni*, I may here mention, had been kept on fresh damp moss and remained alive up to the moment of its final disappearance down the throat of the roller."

(2) *Grades*:—

	1. *E. dryope*, *E. hiarbas*, blackish skipper.
H. perspicua (or, more likely, *M. campina*, with which *H. perspicua* seems to get confused).	2. *N. saclava*, *P. trimeni*, *P. lucretia*, all about equal. 3. *Ypthima*.
	4. Probably *M. yulei* and larva of *A. serena*; for, though the first *Ypthima* may have been eaten under the stimulation of the grasshoppers, it is unlikely that any stimulation would at that stage have induced the roller to eat the *Mylothris* or larva.]

Exp. 56.—*June* 29. Hungry; tasted and rejected *Acræa serena*, and after it with far more marked disgust its larva.

[1. *A. serena*, imago.
2. Its larva.]

Exp. 57.—*June* 30. Refused to touch another grasshopper at the end of a large feed, by the forceps, of chiefly these insects, in spite of my best endeavours to tempt her. She now took but tossed carelessly away into the air a *Precis cebrene*, refused without tasting a *Precis archesia*, refused, then tasted and rejected a *Byblia*, but, attracted by the movements of a *Charaxes neanthes*, leant forward after for some time ignoring it and took, crushed, and swallowed it with evident approval. She now once more refused *Precis cebrene*, this time without tasting, was attracted by a fluttering *Gegenes* and tasted and rejected it; refused without tasting a *Hesperia*, tasted after first ignoring it a *Precis tugela* ⊙ f., and, evidently liking it greatly, crushed and at once swallowed it, and readily accepted, crushed, and swallowed the *Precis archesia* and *P. cebrene* before refused. She then tasted and rejected, but on my again offering it crushed and tasted very thoroughly and finally swallowed the *Gegenes* reoffered, but looked quite doubtful about it, refused but then leaning forward tasted slightly and rejected a *Neptis saclava*, refused persistently without tasting an *Ypthima* and an *Acræa*-like *Baoris*, but after at first refusing it tasted, crushed, and readily swallowed a newly-emerged *Atella phalantha*. She now refused without tasting *Hamanumida dædalus*, *Pyrameis cardui*, and one of her favourite grasshoppers, but was tempted nevertheless by a *P. archesia* which she crushed and readily ate. After it, with equal readiness, she ate a *Precis natalensis* ⊙ f.

After an interval I offered and the bird, noticeably hungrier, crushed and ate without hesitation *Papilio lyæus*, *Leuceronia thalassina* ♀, and the *Byblia* previously rejected, but she tasted and at once rejected *Neptis saclava*.

[Summary, etc.:—(1) *Note at the time*: "The bird was utterly replete, so much so that its acceptance under such circumstances of *Precis archesia*, *P. natalensis* ⊙, *P. tugela*, *Atella phalantha*, and *Charaxes neanthis* would indicate that these five butterflies are exceedingly high-grade. The *Gegenes* was less liked."

(2) *Grades*:—
1. *P. archesia* ⊙ f.
2. *H. dædalus*, *P. cardui*, and a favourite grasshopper.

At first sight it would seem that many more preferences were shown, but I fear I cannot regard them as necessarily *quite* reliable. Thus *C. neanthes*, *P. tugela*, and *A. phalantha* were each eaten after initial refusal: might not the refusals of their respective predecessors have been turned into acceptances by just that extra amount of coaxing? And *P. archesia*, *P. cebrene*, and *P. natalensis* ⊙ f. were each eaten after a possible whetting of the appetite. In the offerings after the interval the acceptances came first and the one refusal after them, so nothing can fairly be deduced.]

Exp. 58.—*July* 3. Tasted and at once rejected *Mylothris agathina* ♀, *Mylothris rueppelli*, and *Mylothris yulei*, but readily ate after crushing them *Phrissura* *isokani*, an *Ypthima*, and two *Charaxes brutus*. She now tasted and rejected *Ypthima* and *Phrissura isokani*, and refused without tasting *Neptis agatha* and *Pinacopteryx pigea*, but then suddenly shaking out her feathers and rousing herself generally she not only crushed and ate the *Pinacopteryx* and the *Neptis agatha* but, only about three minutes later, a *Terias*.

I then gave several grasshoppers, after which she readily ate a *Neptis saclava*, several more grasshoppers, and after them yet another *Neptis saclava*. Then a few more grasshoppers, but they brought her to the point of repletion, for she now refused without tasting not only *Gegenes*, *Byblia*, and *N. saclava*, but a *Tagiades flesus* and a *Pyrameis*. She then crushed and swallowed *Hamanumida dædalus* after at first refusing it, crushed slightly and tossed carelessly away into the air a ♂ *Catopsilia florella* and a *Pyrameis cardui*, crushed and swallowed after at first refusing it a yellow ♀ *Catopsilia*, then refused without tasting *Salamis anacardii*, *Precis cebrene*, *Pyrameis cardui*, *Tagiades flesus*, *Hamanumida dædalus*, and ♂ *Leuceronia argia*.

[SUMMARY :—

1. *P. isokani*.
2. *M. agathina* ♀, *M. rueppelli*, *M. yulei*.

It would be unsafe to deduce anything further from an experiment showing such caprices of appetite.]

Exp. 59.—In the late afternoon, having kept the bird without food for some hours, I offered a *Terias*. She at first ignored it but finally just took it in the point of her bill and tossed it away, afterwards refusing with violent head-shakings, clapping of the bill, and other unmistakable signs of recognition and dislike, to touch a *Nychitona medusa*. A ♀ *Mylothris rueppelli* was, however, very thoroughly crushed and swallowed, though a ♀ *Mylothris agathina* and a ♀ *Mylothris yulei* were each at once rejected on being tasted. I now offered a ♂ *rueppelli*. This was accepted, very thoroughly crushed, and finally half-swallowed, but brought up again, again well crushed, and in the end dropped. On my twice reoffering it, it was the first time well crushed and dropped and on the second occasion just crushed slightly and rejected. *Mylothris agathina* and *Mylothris yulei* were reoffered, but the bird refused to have anything to do with them. There could be no doubt at all that the *M. rueppelli* was preferred to either (all were quite freshly caught) and that a very large *Terias* which I now offered was preferred to even *M. rueppelli*, for the bird just crushed it slightly and swallowed it. Evidently she had not quite "woken up" when I first offered it. Immediately afterwards she tasted and most emphatically rejected the *Nychitona* and an *Acræa serena*, shaking her head after each with marked disapproval. I then reoffered the *Mylothris rueppelli*, which was once more *well* crushed and rejected, the *Mylothris agathina*, which was recognized and refused with shakes of the head, and the *Mylothris yulei*, which was tasted and at once emphatically rejected. She now once more crushed and simply dropped the *M. rueppelli*, but ate with the greatest readiness a *Neptis saclava*. In order that the bird might the more readily differentiate them, I had offered throughout the *Mylothris* *rueppelli* with a forewing attached, the *M. agathina* with a hindwing, and the *M. yulei* with both a fore- and a hindwing on the same side.

I now gave the bird four smallish grasshoppers, which were eagerly eaten—it was evident that she had been very fairly hungry. She then refused obstinately without tasting a small *Terias senegalensis*, refused only for a moment but then crushed and readily ate a *Neptis saclava*, again most obstinately refused the *Terias* without tasting, but readily ate after crushing them slightly a second *Neptis saclava* and an *Ypthima*.

She then, after eating a *Charaxes brutus* and a *Charaxes cithæron* (wingless), refused persistently without tasting a *Neptis saclava* and an *Ypthima*, but finally tasted the latter and emphatically flung it to the other side of the cage. She then tasted and rejected (but without emphasis) *Neptis saclava*.

I now gave her two wingless *Charaxes brutus* which were most readily eaten, and a *Papilio lyæus* with one wing which was crushed very thoroughly and eaten very waveringly.

Having eaten two more large *Charaxes* (*candiope*), the bird obstinately refused a *Papilio lyæus*, refused but then tasted and rejected a *Leuceronia argia* ♂, and refused without tasting a ♂ *Catopsilia florella* but took a *C. cebrene*. But she was evidently replete, for after playing with and finally eating the *Precis cebrene* with undoubted disinclination, she simply crushed and dropped a *Pyrameis*. However, a *Charaxes neanthes* now attracted her curiosity by its violent movements and was crushed well and readily eaten, but the bird then merely took and tossed carelessly into the air in turn an *Atella phalantha*, a *Crenis boisduvali* or *natalensis*, a *Precis cebrene*, a *Pyrameis cardui*, and one of her favourite grasshoppers.

Five minutes later she crushed and readily enough ate a *Pyrameis*, refused positively without tasting the *Crenis* and a *Precis cebrene*, refused but at once changing her mind accepted, crushed well, and swallowed with evident appreciation a *Salamis anacardii*, and after it a large ♂ *Catopsilia*, refused obstinately without tasting a *Leuceronia argia* ♂, a *Pyrameis cardui*, a *Precis cebrene*, a *Melanitis leda*, and a second *Catopsilia florella*. I now reoffered the *Melanitis*, which was at first ignored but afterwards accepted, well crushed, and eaten. The bird then tasted and rejected *Leuceronia argia* ♀, but readily ate after crushing it a *Catopsilia florella*, then crushed and rejected a *Papilio lyæus* ♀.

Five minutes later she tasted and rejected *Leuceronia argia* ♂, but readily enough ate a *Pyrameis*, a *Precis cebrene*, the *Crenis*, a *Macroglossa trochilus*, and a *Pyrameis*, but was very evidently anything but hungry.

Five minutes later she tasted and rejected the *Leuceronia*, a *Eurytela hiarbas*, a light-coloured *Byblia*, readily enough ate a *Hamanumida dædalus*, and a *Rhopalocampta libeon* without smell, refused obstinately without tasting a dark *Byblia*, but readily ate a *Tagiades flesus* and a *Rhopalocampta pisistratus* without trace of smell.

Five minutes later she refused without tasting the *Leuceronia*, *Hamanumida dædalus*, *Precis cebrene*, and *Pyrameis cardui*, being evidently satisfied. Finally, much bored by my attempts at persuasion, she retired to the furthest perch and turned her back to me.

An hour later, by lantern-light, I offered an *Ypthima* and a *Neptis saclava*, each of which was tasted and promptly rejected. The *Leuceronia argia* ♂ was, however, eaten after very thorough crushing; *Eurytela hiarbas* with two wings was crushed and rejected, and *Papilio lyæus* ♀ was very thoroughly crushed and swallowed. The bird then tasted and rejected *Eurytela hiarbas* with only a hindwing, tasted and at once readily swallowed a *Precis cebrene*, crushed well and rejected the *Eurytela*, this time without wings, and tasted and very emphatically rejected the dark *Byblia*.

The bird certainly gave everything a much fairer tasting than usual in this last experiment, being probably unable to distinguish the colours well by lantern-light.

[SUMMARY, ETC.:—(1) *Note at the time*: "The object of the whole experiment had been to place *Crenis*, and to obtain a further opinion from the roller on the relative unpalatability of *Catopsilia florella*, *Leuceronia argia*, *Papilio lyæus*, and *Eurytela hiarbas*. In this I partly failed, but the bird was throughout in excellent form and the results, so far as they went, appeared to me to be particularly trustworthy. *Atella* was unluckily lost, so could not be reoffered."

(2) *Grades*:—

1. *S. anacardii* and perhaps *C. neanthes*.
2. *P. cebrene*, } *P. cardui*, *H. dædalus*, and *T. flesus*.
3. *C. florella*, }
4. *L. argia* ♂ and *P. lyæus* ♀.
5. *E. hiarbas*.
6. *N. saclava* and *Byblia*.
7. *Ypthima* and *Terias senegalensis*.
8. *M. rueppelli* ♂ and ♀.
9 *M. agathina* ♀ and *M. yulei* ♀.
10. *N. medusa* and *A. serena*.

One link in the above was weak, and to mend it I had to use my knowledge (from other experiments) that *Byblia* and *N. saclava* are approximately equal in the roller's estimation.

Actually *Ypthima* was eaten in apparent preference to *Terias senegalensis*, and were it not for the possibility of special stimulation would constitute an additional grade between *Neptis* (definitely preferred to *Terias*) and *Terias*. Were it not for the same complication *R. libeon* and *R. pisistratus*, the *Crenis*, and *Macroglossa trochilus* might be inserted on a level with at any rate *Pyrameis*.

But even without all this the results are very full, and I have not hesitated to deduce from differences in manner which were particularly good in this experiment.]

Exp. 60.—*July* 4. Crushed and rejected *Mylothris yulei*, but readily ate *Neptis saclava*, and after it a few small grasshoppers and another *Neptis saclava*.

I now offered two large grasshoppers which were readily eaten, the bird then tasting and rejecting a *Byblia* but crushing and readily eating a *Neptis agatha*. She next refused for some time but finally crushed well and swallowed a *Neptis* *saclava*, tasted and rejected *Phrissura isokani*, refused an *Ypthima* and the *Byblia* persistently without tasting, then tasted the *Ypthima* reoffered, and rejected it, refused for a second or two only (thinking of *saclava* ?) but changing her mind accepted and ate *Neptis agatha*, then tasted and rejected the *Byblia* (a dark individual) and a *Phrissura isokani*, and refused obstinately to touch an *Ypthima*. I now offered a large brightly-coloured strongly-smelling locust, *Phymateus viridipes*. The bird at once seized on it, but after running it through her bill and tasting it well all over without however actually crushing it, dropped it, but without special sign of dislike. She refused it without tasting on its being reoffered.

Exp. 61.—In the late afternoon I offered the bird *Mylothris rueppelli* ♂. This, after at first refusing, she tasted and at once rejected, then refused for some time but finally accepted, crushed, and swallowed without further hesitation a *Terias brigitta*, after this once more tasting slightly and rejecting the *Mylothris rueppelli*.

I now gave her the *Phymateus viridipes*, which she accepted, crushed and battered very thoroughly indeed against the perch, taking some time over it, so that her mouth must have been full of its taste, and finally ate it without hesitation or any sign of dislike. She then obstinately refused to touch *Terias brigitta* or a *Phrissura isokani*, crushed thoroughly and threw away an *Ypthima*, refused without tasting a *Byblia*, readily accepted a *Neptis saclava*, crushed and swallowed it, and after it an *Ypthima*, once more refusing to have anything to do with the *Terias* or with *Phrissura isokani* ♂ or ♀.

I now gave her a large grasshopper and a small one. She then crushed and dropped but on my reoffering each crushed once more well and swallowed a *Papilio lyæus* and a *Leuceronia thalassina*. I could see no difference in her treatment of the two species.

She then *readily* ate a *Charaxes brutus*, afterwards crushing and rejecting a *Papilio lyæus*, and refusing for some time but in the end, on my removing the wing, similarly crushing and rejecting *Leuceronia argia* ♀.

[Summary, etc.:—(1) *Note at the time*: "There seemed to be nothing much to choose in point of acceptability between *Papilio lyæus* and the *L. thalassina*. The roller yesterday showed rather more suspicion of *Leuceronia argia* until I removed the wing. Perhaps the latter reminded it too much of that of *Mylothris agathina*.

Phymateus viridipes, on the strength of having found which genus in their stomachs both Marshall and I based an idea of the indiscriminate tastes of rollers in general, is here shown to be lower, probably, than *Neptis saclava* and *agatha*, but probably rather higher than *Terias brigitta*—though its more deliberate crushing may have been merely because less well known of late than the *Terias*."

(2) *Grades* :—

1. *Charaxes brutus*, on manner above
2. *L. thalassina* and *P. lyæus*, *N. agatha* and *N. saclava*.

M. yulei. {
3. *Ypthima*. } *Phymateus viridipes*, *Byblia*, and *P. isokani*.
4. *Terias brigitta*. }
5. *Mylothris rueppelli*.]

Exp. 62.—*July* 5. Tasted and at once rejected *Acræa caldarena* and refused without tasting *Acræa acara* and *Amauris lobengula.* She then ate several grasshoppers, crushed and rejected *Mylothris rueppelli*, and obstinately refused without tasting a *Terias*, but readily ate a *Neptis saclava* and an *Ypthima*, rejected after tasting it a *Phrissura isokani*, crushed and dropped but on my reoffering it ate readily a *Rhopalocampta forestan* with a very strong *Amauris*-smell, which was presumably what obtained its rejection when first tasted.

Fifteen minutes later, after an interruption, she refused without tasting a *Terias*, refused, then tasted and rejected a *Phrissura isokani*, and ate with the greatest readiness and no sign of dislike seven *Neptis saclava*, one *Ypthima*, and one *Neptis goochi* in rapid succession, first slightly crushing each.

She now ate five small grasshoppers, refused without tasting a *Neptis saclava* and an *Ypthima*, refused, then tasted *Neptis goochi*, but at once emphatically rejected it and proceeded to wipe her bill vigorously on the perch, refusing then without tasting a *Neptis agatha.*

After three more small grasshoppers she tasted and rejected a *Papilio lyæus* ♀, persistently without tasting refused a *Leuceronia argia* ♂ (as always, with one hindwing), but recognized and at once crushed and readily ate a *Catopsilia florella*, differing hardly at all in general appearance from the *Leuceronia* except in the latter's greener and more conspicuous eyes. She then once more refused without tasting the *Leuceronia argia*, also a *Eurytela dryope*, then leaned forward, barely tasted the *argia*, and withdrew, leaving it in the forceps. However, she was evidently replete in any case, for she now just crushed and dropped or refused without tasting several edible grasshoppers and refused again without tasting *Precis cebrene*, *Pyrameis cardui*, and *Precis archesia.*

Ten minutes later she tasted warily and rejected *Leuceronia argia* ♂ and *Eurytela dryope*, but crushed and ate with apparent relish a large green Pentatomid bug, *Encosternum delegorguei.*

I continued the experiment—one object of which was to obtain an opinion from the bird on the relative merits of *Leuceronia* and *Papilio lyæus*—an hour later, by lamplight. She commenced by tasting and rejecting *Eurytela hiarbas*, then crushed and readily ate *Papilio lyæus*, *Leuceronia argia* ♂, and a *Charaxes brutus*, crushed and dropped but on my reoffering it crushed very thoroughly and ate *Papilio lyæus*, tasted suspiciously or with disinclination and rejected two ♀ *Leuceronia argia* in succession, accepted readily but after crushing it well with a doubtful look threw away *Papilio dardanus* ♂, and once more tasted and rejected *Eurytela dryope* and the two *Leuceronia argia* ♀s. She now for some time refused to touch *Papilio dardanus* ♂, then crushed and rejected it, but on my reoffering and continuing to hold it to her, crushed it well and swallowed it with evident suspicion or disinclination.

She next refused persistently without tasting but in the end tasted and once more rejected both the *Leuceronia argia* ♀s, tasted slightly (after at first refusing) and rejected *Eurytela dryope*, but crushed and readily ate a "swift" moth with very slight tomato-smell, ten minutes later again tasting and rejecting *Leuceronia argia* ♀ and *Eurytela dryope.*

I now gave her a few grasshoppers, and on her refusing absolutely to touch another offered her a *Pyrameis cardui*, a *Precis archesia*, a *Catopsilia florella*, and a *Precis cebrene*, all of which were persistently refused without tasting.

Ten minutes later the bird tasted and rejected *Leuceronia argia* ♀ and *Eurytela dryope*, ate readily after slightly crushing each two *Precis archesia* and a *Precis elgiva*, but was evidently nearly replete, for she now just crushed slightly and threw aside a second *Precis elgiva* and a *Pyrameis cardui* and refused without tasting a *Precis cebrene* and a *Precis natalensis* ⊙ f.

Five minutes later she refused without tasting *Precis elgiva*, *Pyrameis cardui*, *Precis cebrene*, *Precis antilope*, and *Cyrestis camillus*, crushed slightly and dropped *Precis natalensis* ⊙ f., crushed and ate a yellow *Catopsilia*, and then crushed and readily ate the ⊙ *Precis natalensis* on my reoffering it. She then crushed and tossed aside a *Pyrameis*, refused without tasting a *Precis cebrene*, crushed and swallowed a *Hamanumida dædalus*, again refused without tasting a *P. cebrene*, but crushed and swallowed a second *H. dædalus*, refused without tasting a *Precis antilope*, and crushed and readily ate an *Atella phalantha*.

Only three minutes later she readily ate, after slightly crushing each, the *Precis antilope*, a common cockroach, a *Precis cebrene*, a *Pyrameis cardui*, and a *Precis clelia*, refused obstinately without tasting a *Cyrestis camillus* and a *Teracolus* (?) (mimic of *Leptosia*), refused, then crushed and swallowed a *Hesperia* without smell, and refused, then tasted very slightly and dropped a dark skipper, afterwards refusing it persistently without tasting.

[Summary:—(1) *Grades*:—

(*a*)

1. Swift-moth and *Encosternum delegorguei*. } 1. Grasshoppers, *C. florella*, *H. dædalus*, *A. phalantha*.
2. *P. elgiva*, *P. cebrene*, *P. antilope*, and *P. natalensis* ⊙ f.,

2. *P. lyæus*.
3. *E. hiarbas*. } *P. dardanus* perhaps slightly above *L. argia* on manner.
3. Probably (for they were below *P. archesia*) *L. argia* ♀ and *E. dryope*.

With 2 and 3 may also be bracketed *P. cardui*, *N. saclava*, *N. agatha*, *N. goochi*, and *Ypthima*. Also whatever the *Cyrestis* (not tasted) and *Teracolus* were taken for.

(*b*) 1. *C. florella*.
2. *N. saclava*. } *R. forestan*.
3. *Terias*, *P. isokani*, *M. rueppelli*, *A. caldarena*, *A. acræa*, *A. lobengula*.

The hasty dropping of the *R. forestan*, probably on account of its *Amauris*-like smell, reminds one of the bird's dropping of the Cetoniid, *Neptunides polychrous*, on its commencing to buzz.

(2) A note states the following order, based presumably mainly on manner:—

1. *P. lyæus*.
2. *P. dardanus*.
3. *L. argia* ♀. } *E. dryope*.
4. *E. hiarbas*.

As it was made with the experiment fresh in my mind it deserves consideration, but I should not deduce quite so much from the experiment as it stands recorded.

(3) *P. antilope*, *P. cebrene*, *P. clelia*, *P. cardui*, a *Hesperia*, and a common cockroach were all, even allowing for special stimulation, eaten fairly near repletion-point.

(4) The recognition and ready acceptance of *Catopsilia* after an obstinate refusal of *Leuceronia argia* ♂, differing from it in appearance chiefly (to speak roughly) in the colour and greater prominence of the eyes, suggests perhaps how such fine points in mimicry as the fulvous palpi of *Pseudacræa trimeni* may have been brought about. It must be remembered that the capture of an insect is not equivalent to its death, which would usually only take place as the result of the subsequent crushing process. Small resemblances which can only be detected at the closest quarters, as when the insect is already in the bill, will therefore have a chance of counting.]

Exp. 63.—*July* 6. I had put in a handful of grasshoppers and other Orthoptera, nearly all of which probably belonged to high-grade species. The bird merely leant over and scanned them from her perch at the top of the cage, then resumed her usual position of repose with a shake of the head that seemed to indicate "No, I can't be bothered to go down."

Half an hour later, as the grasshoppers still remained untouched, I offered the smaller ones one by one in the forceps. The bird readily ate eight, then refused persistently without tasting an *Ypthima*, a *Pseudacræa lucretia*, and a *Teracolus*, ate another grasshopper, but merely crushed and threw away a second and refused without tasting all of many others that I now offered her. She also refused without tasting a *Cyrestis camellus*, a *Leuceronia argia* ♀ (without wings) and a *Eurytela dryope*, but quite readily accepted and ate a *Precis cebrene*.

Later, by lamplight, she crushed and readily swallowed *Leuceronia argia* ♀, tasted and rejected *Eurytela dryope*, *Cyrestis camillus*, an *Ypthima*, a *Teracolus* (?), and, after thorough crushing, *Pseudacræa lucretia* and again the *Cyrestis*. She then ate with relish *Pyrameis cardui* and *Precis cebrene*, and after them the *Eurytela dryope* and the *Pseudacræa* (with all wings) after prolonged crushing, tasted and rejected once more the *Cyrestis*, refused, then changing her mind crushed and swallowed the *Teracolus*, rejected a dead but supple *Neptis goochi*, but on its being reoffered ate not only it but a second, and refused a *Terias brigitta* (?). She finally, however, tasted and rejected it.

[SUMMARY :—

(*a*) 1. *P. cebrene.*
    2. Grasshoppers.
    3. *C. camillus*, *E. dryope*, *L. argia* ♀.
(*b*) 1. *Pyrameis cardui.*
    2. *C. camillus*, *E. dryope*, *Ypthima.*

It is probable that *E. dryope*, *C. camillus*, *Ypthima* and the *Teracolus* were at any rate not liked better than *L. argia* ♀, *Cyrestis camillus* than *Ps. lucretia*, or *T. brigitta* than *N. goochi* and the *Teracolus*.]

Exp. 64.—*July* 7. I fed the roller by hand on grasshoppers &c. until she would eat no more. She then crushed and tossed carelessly aside a *Precis cebrene*, examined critically and shook her head at a large wasp, *Belonogaster dubius* (which I killed immediately before offering it), but changing her mind tasted it slightly and dropped it. On my reoffering it, she ran it through her bill from side to side, tasting it well, and dropped it. I reoffered it once more, when it was merely tasted slightly and dropped.

Ten minutes later, evidently still replete, she at first ignored, but then took, crushed and swallowed *Precis cebrene*, and crushed slightly and tossed aside the hornet.

Ten minutes later she refused, then tasted slightly and dropped the hornet, but readily ate a *Precis cebrene*.

Twenty minutes later she refused persistently without tasting an *Ypthima*, an Acræoid skipper (*Baoris nyassæ*), and a Lycoid moth, but ate readily *Precis cebrene*, and after at first dropping it crushed very thoroughly and swallowed the hornet—without sign of dislike. She then crushed slightly and swallowed a *Precis clelia*, again refused the skipper and the Lycoid moth, then tasting the latter slightly (it had no smell that I could detect) rejected it, ate readily a *Pyrameis*, but tasted and at once rejected a *Neptis saclava*, readily accepted and ate a *Precis cebrene*, but tasted slightly and rejected the Lycoid moth, crushed and dropped, probably accidentally, a *Papilio lyæus* and on my reoffering it crushed it well and swallowed it without apparent dislike, refused without tasting the Lycoid moth, tasted and promptly rejected *Neptis agatha*, and crushed and at once swallowed a *Hesperia* (of usual species) with slight bug-smell.

[SUMMARY :—

(*a*) 1. *P. cebrene.*
2. *Bel. dubius*, probably but not certainly above "3." } *P. cardui*, *P. lyæus*, *Hesperia*.
3. *Ypthima* and the Lycoid moth.
(*b*) 1. *P. cebrene* and probably *P. lyæus.*
2. *N. saclava.*
(*c*) 1. *Hesperia* sp. (bug-like smell).
2. *N. agatha*, which probably not above *P. lyæus.*

The roller's treatment of the *Belonogaster* precluded the idea that the sting may have had anything to do with its placing.

The Acræoid skipper was probably refused through its likeness to an *Acræa*. Similarly, it is quite probable that the first refusal of the Lycoid moth was not on its own known merits.]

Exp. 65.—*July* 9. Rejected with the greatest emphasis a larva of *Acræa serena*
[State of hunger unfortunately not indicated.]

Exp. 66.—*July* 11. Hungry, ate two small pieces of meat, crushed and tasted well and swallowed without any hesitation a pupa of *Acræa serena*, then recognized and refused its larva without tasting and with violent shakes of the head. She then crushed and readily ate a *Terias* and *Belenois severina*, but tasted and threw right away a ♂ *Mylothris agathina.*

[At the time I was convinced that the *serena* pupa was far better liked than the larva, even perhaps than *M. agathina* ♂, and commented—"The roller's behaviour on being shown the larva to-day was indicative of nothing less than horror." Reading the experiment now, and contrasting the great difference in manner, I still think that I may have been right, but it does not necessarily follow from the experiment. The possibility of special stimulation by the meat and inhibition by the pupa, and the fact that the acceptance and refusals came in the wrong order, necessitates caution. *Terias* was preferred to the *serena* larva, and probably ♂ *M. agathina* was liked at any rate not better than *B. severina.*]

Exp. 67.—*August* 1. Hungry; tasted and at once rejected *Mylothris agathina*, readily accepted, crushed, and ate two *Terias senegalensis*, accepted, crushed and battered very thoroughly, and finally swallowed a large dark green *Phymateus* with a strong unpleasant smell reminding one of Cascara sagrada and the leaves of *Datura Stramonium.* She now refused without tasting *Terias senegalensis*, tasted slightly and rejected the common Coccinellid, *Epilachna hirta* (exuding a yellow juice), refused persistently without tasting and with violent and continued shakes of the head a large, brilliant-metallic, black-spotted bug, *Cryptacrus comes*, common on *Croton sylvaticum*, readily accepted, crushed, and ate *Neptis saclava*, and refused obstinately without tasting it a second dark green *Phymateus.*

The refusal of the second *Terias* was evidently simply due to the *Phymateus* having filled the roller's stomach to a point in advance of the *Terias*-eating stage. All that can be deduced with regard to the *Phymateus* (which was exuding bubbles from behind its posterior pair of legs) is that it is likely to be unpleasanter than *Neptis saclava* and less so than *Mylothris agathina.* It is probably on a level with *Terias.* The refusal of the *Cryptacrus comes* (which I have found in the stomach of a wild bulbul, *Pycnonotus layardi*, v. 'Ibis,' 1908, p. 66) may have been due (1) to a previous knowledge of it or (2) to a mere distrust of its gaudy coloration.

I now proceeded to feed the bird up on grasshoppers, etc., until she absolutely refused to touch another. She then tasted and rejected *Eurytela dryope*, leaned forward evidently much tempted by a huge green Pentatomid bug, *Encosternum delegorguei*, which I now passed through the bars, but withdrew with a shake of the head without having tasted it, and refused without tasting *Antanartia schœneia* and *Precis cebrene.*

Ten minutes later she refused without tasting *Eurytela dryope*, *Antanartia schœneia*, and *Precis cebrene*, but accepted, crushed very thoroughly, and swallowed head first the big green *Encosternum* (it smelt very strongly on being crushed, not much before), and once more refused *Precis cebrene* and a common small grey Pentatomid bug. She kept on opening her mouth, doubtless in connection with what she had just swallowed, but whether this was to be interpreted as a sign of pleasure or the reverse I could not say.

Fifteen minutes later she tasted and rejected *Eurytela dryope*, but crushed and readily ate *Papilio lyæus* and *Papilio demodocus*, then obstinately refused *Eurytela dryope* without tasting, then ate four smallish grasshoppers and refused the next, also refusing *Papilio lyæus*, then three more grasshoppers and refused the next, also *Antanartia schœneia*. After a short interval *A. schœneia* and *P. cebrene* were once more offered, as well as a number of grasshoppers, but all were refused without tasting.

[SUMMARY:—(1) "There could be no doubt of the roller's enjoyment of the *Encosternum*, which was eaten in preference to the usually highly-placed *Precis cebrene*."

(2) *Grades*:—

(*a*) 1. *N. saclava.*
Cryptacrus comes. *E. hirta.* { 2. *Terias senegalensis* and *Phymateus* (latter if not result of stimulation).
3. *M. agathina.*
(*b*) 1. *Encosternum delegorguei* (small grey sp., at any rate, not liked better).
A. schœneia. *P. cebrene.* { 2. Grasshoppers.
3. *P. lyæus* (and *P. demodocus* ? ?).
4. *E. dryope.*]

Exp. 68.—*August* 6. Tasted and rejected *Mylothris agathina* ♀ and *Terias brigitta*, afterwards refusing to touch the latter most obstinately. I then offered it a dull green *Phymateus* (a large specimen). The bird, though hungry, refused to have anything to do with it, retreating away along the perch whenever I brought it near. I then substituted for it *Phymateus viridipes*. The roller, which had retired to an inaccessible corner, at once on seeing it flew up, seized it, and after crushing it well, swallowed it with no indication of dislike. She then tasted and rejected once more the *Terias*, but crushed and very readily ate an *Ypthima*, of which there are still a good many about.

[SUMMARY:—(1) *Note*: "The dark green *Phymateus* was remembered with such evident dislike that though there was still nothing to indicate that it should be placed below *Terias* it would, I believe, have been placed well below it had the bird been hungry enough to eat that butterfly. The red-winged *Phymateus viridipes* was liked very much better, though not necessarily more than *Ypthima*."

(2) *Grades*:—

1. Red-winged *Phymateus* and *Ypthima*.
2. Dark green *Phymateus*, *T. brigitta*, and *M. agathina* ♀.]

Exp. 69.—*August* 7. Refused without tasting, then simply took from the forceps and threw away *Mylothris agathina*, refused also but then tasted slightly and threw away a *Terias*, but crushed and readily ate a *Mycalesis campina*, tried to crush but finally rejected in annoyance or despair a very hard *Acridium lineatum*, ate three smallish grasshoppers, refused persistently without tasting *Neptis saclava*, crushed and at once rejected *Eurytela dryope*, crushed well and rejected, though less promptly than the *Eurytela*, a *Leuceronia argia* ♀, and crushed and ate (it took it some time to get it into good head-first position, with the result that it must have tasted it very thoroughly) a *Papilio lyæus* ♀. All these tastings were thorough and satisfactory.

Five minutes later she crushed well and ate *Leuceronia argia* ♀, refused without tasting, then tasted slightly and rejected *Eurytela dryope*, but crushed and readily ate a *Henotesia perspicua*. She then once more refused but ended by slightly tasting and rejecting *Eurytela dryope*, but on my reoffering it ate not only it but *Neptis agatha*. It then refused for a time an *Ypthima*, but on my continuing to hold it to her crushed and swallowed it.

[Summary :—

(*a*) 1. *M. campina*, small grasshoppers.
2. *M. agathina* and *Terias* (and small grasshoppers above *Acridium lineatum*).
(*b*) 1. *P. lyæus* ♀. } *H. perspicua.*
2. *L. argia* ♀ }
3. *E. dryope*, *N. saclava*, *Acridium lineatum*, and *Terias*.]

Exp. 70.—*August* 8. Refused persistently without tasting *Mylothris agathina* ♀ and a *Terias*. She then ate several grasshoppers of various species, but finally, through sheer repletion apparently, refused to touch any more. She now refused and then carelessly crushed and tossed aside a *Precis cebrene* and an *Antanartia schœneia*.

Four minutes later she once more took *Precis cebrene* in the tip of her bill after at first refusing it and tossed it away.

Fifteen minutes later she readily ate a *Precis cebrene*, a *Papilio lyæus*, and a medium-sized grasshopper, but refused without tasting the next grasshopper (usually a favourite), also *Charaxes brutus*, and refused, then crushed and tossed aside, but on my offering for the third time once more crushed and this time swallowed a ♀ *Papilio lyæus*. I now offered her several species of grasshoppers, including most of her favourites, and she refused to touch any of them, then simply played with *Charaxes brutus* and *Precis cebrene*, tossing them into the air and catching them, and finally allowing each to fall. *Papilio lyæus* was tasted and rejected, and an *Antanartia* was taken, crushed slightly, and listlessly tossed away into the air. She then took a *Euralia mima* and was crushing it in the same careless fashion when, evidently specially attracted by it, she suddenly set to work more energetically, worked it round into a good head-first position, crushing it well the while, and swallowing it hindwing and all, though the latter was a distinct hindrance to the butterfly's passage. (N.B. The *Charaxes brutus* had been wingless.) She now obstinately refused to touch *Papilio lyæus*, *Precis cebrene*, *Charaxes brutus*, *Pyrameis cardui*, *Antanartia schœneia*, or any of the series of grasshoppers which I had offered previously.

Ten minutes later, still evidently feeling replete, she refused, then just took and tossed away, an *Antanartia schœneia* and a *Precis cebrene*, and refused without tasting *Charaxes brutus* and the grasshoppers.

[Summary :—(1) *Note at the time*: "In view of her inability (through repletion) to eat either the *Charaxes*, the *Junonia*, or her favourite grasshoppers, it came as a surprise to me that she was so immensely attracted by the *Euralia*, which she ate with unmistakable relish. Evidently to her it was very acceptable indeed."

(2) *Grades*:—

1. *Euralia mima*.
2. *P. cebrene*, *C. brutus*, *A. schœneia*, *P. lyœus*.

The previous *P. lyœus* was accepted only near repletion-point, but in view of its refusal and rejection just before, and the obvious growth of appetite required to get it accepted, it cannot be placed necessarily above *C. brutus*.]

Exp. 71.—*August* 11. Very hungry; readily accepted and ate *Terias brigitta*, then, very hesitatingly, a *Mylothris agathina* ♀ with very little smell, crushed and rejected a *Mylothris rueppelli*, crushed it very thoroughly indeed and finally rejected it on its being reoffered, then refused and, on my persisting, tasted and at once rejected a *Mylothris agathina* ♂ with the usual sweet-brier scent, but readily accepted and ate a *Terias senegalensis*. I then offered her the dull green and blue *Phymateus*. It was accepted, crushed very thoroughly, and at last swallowed. The bird then refused but, on my continuing to offer it, tasted and rejected *Terias brigitta*, but crushed and very readily ate *Belenois severina*, once more refusing the *Terias* without tasting. She then eagerly ate several grasshoppers, readily ate *Neptis agatha*, refused obstinately to touch *Belenois severina*, but once more readily accepted and ate *Neptis agatha*.

I then gave her six small grasshoppers, after which she crushed and ate *Eurytela dryope*, refused without tasting *Neptis agatha*, and tasted very slightly and threw aside a second *Eurytela dryope*, readily eating, however, a *Papilio lyœus*. She next refused, then tasted and rejected *Leuceronia thalassina* ♂, refused, then tasted, crushed and ate *Papilio demodocus*, tasted and rejected *Papilio angolanus*, then refused persistently without tasting *Papilio demodocus* and *Papilio lyœus*, also the red-winged *Phymateus viridipes*, which was offered with its wings spread and ignored. I then closed its wings and reoffered it in that position. The bird, which was at the further end of a perch, at once sidled up, looked at it closely, and then at once sidled back again without touching it.

Ten minutes later she readily ate *Papilio lyœus*, but crushed and rejected *Leuceronia thalassina* ♂ and *Papilio angolanus*, refused momentarily, then accepted, crushed well, and ate *Papilio demodocus* and, evidently just too replete for it, persistently refused *Papilio lyœus* without tasting.

After an interval she crushed well and very nearly ate *Leuceronia thalassina* ♂, but at the last moment rejected it, then refused without tasting *Eurytela dryope*, tasted and rejected the *Phymateus viridipes*, and refused without tasting *Papilio lyœus*.

An hour later she tasted and rejected *Neptis agatha* and *Eurytela dryope*, but ate readily *Leuceronia argia* ♀, crushed thoroughly for a long time and rejected the *Phymateus viridipes*, then, suddenly waking up, readily ate *Eurytela dryope* and *Neptis agatha*, tasted and rejected the *Phymateus*, ate readily a *Papilio lyœus* and a *Neptis agatha*, but tasted and rejected a *Terias brigitta*, as also once more the *Phymateus viridipes*.

[SUMMARY :—
(*a*) 1. *N. agatha.*
2. *B. severina.*
3. *T. senegalensis.*
4. *M. rueppelli* and *M. agathina.*
(*b*) 1. *P. lyæus*, *P. demodocus*, and *L. argia.*
L. thalassina ♂. { 2. *E. dryope.*
N. agatha.
P. angolanus. 3. Red *Phymateus.*

In arranging (*b*) I am assuming to be correct the indication that *P. lyæus* was not appreciably better liked than *P. demodocus*. *L. argia* having been placed above *E. dryope* and *L. thalassina* below *P. demodocus*, it is possible that the two Leuceronias should together form a grade intermediate between 1 and 2.]

Exp. 72.—*August* 21. Crushed and at once rejected *Mylothris agathina* ♂, readily ate *Neptis agatha*, eight small grasshoppers and a second *Neptis agatha*, tasted and rejected a *Mycalesis campina*, tasted and rejected a Syntomid moth (*Syntomis cerbera*) offered without wings, readily ate a large Coreid bug with strong smell (*Petascelis remipes*) after crushing it well, also a third *Neptis agatha*. She then tasted well and rejected an Ichneumon, *Osprynchotus flavipes*, also a second *Syntomis cerbera* (with wings), then crushed well and readily ate a second large Coreid bug of the same species, tasted very slightly, suspicious perhaps of the colour, and rejected and afterwards refused without tasting a small bright red beetle, crushed very well and rejected doubtfully the pupa of *Acræa serena*, refused, then barely tasted if at all a *Teracolus* with one forewing attached and dropped it.

A large baboon was at this moment detected watching us intently from an eminence close by, doubtless awaiting an opportunity of slipping in amongst the ripening coffee. I could not resist the temptation of a shot. On my return not many minutes later I gave the bird six very small grasshoppers to balance any alteration of appetite that the delay might have occasioned. She evidently, however, still remained somewhat hungrier than before (or was whetted by the grasshoppers), for she now ate not only a *Neptis agatha* and the *Teracolus* (after at first refusing the latter without tasting), but also a *Mycalesis campina*. I had no *Belenois* or *Terias* at the moment to offer, but the bird tasted and once more rejected *Mylothris agathina* with marked disgust.

A second interruption, longer than the first, now occurred. After it the bird played for a few seconds with *Mylothris agathina* ♂, repeatedly tossing it into the air and catching it. The last time she did not trouble to take it as it descended, and on my reoffering it refused it without tasting. She next tasted and at once rejected the first *Syntomis cerbera*, crushed and tasted very thoroughly indeed, running it time after time through her bill and evidently doubtful whether to swallow it, the pupa of *Acræa serena*, from which the juices were already exuding as the result of the first tasting. She at last swallowed it, but had barely done so when she at once brought it up again and rejected it, afterwards refusing it without tasting. She then refused without tasting, but on my continuing to offer it, crushed and at once rejected the large common orange and black Ichneumon, *Osprynchotus flavipes*, as also a smaller one, probably the ♂, this time without wings, tasted and rejected and then refused persistently to taste again a "red-cross" *Lygæus* bug, without the usual bug smell but with a *very* faint smell of its own. I was a little doubtful of the value of the tasting, so I brought the usual grasshopper tin into view of the cage, having previously inserted the bug into it. The bird, as I knew it would, recognized the tin, at once came forward eagerly and ate readily and apparently almost without tasting the first five very small grasshoppers that I offered. I now quickly offered the bug. The bird accepted it in all confidence and without troubling to first glance at it, but at once, in the very act of throwing up her head to jerk it into the back of her throat, recognized it as unpleasant, and at once checking herself flung it to the other side of the cage. I twice again played the same trick, offering first a very small grasshopper which was eagerly eaten, and then the bug, which was each time taken as thoughtlessly as at first, but at once recognized by taste and flung away with unmistakable signs of dislike.

I then gave ten more very small grasshoppers, after which *Papilio lyæus*, *Papilio dardanus* ♂, and *Eurytela dryope* were readily accepted and eaten. Not replete enough for my purpose.

After seven more the bird rejected *Eurytela dryope* (it had, however, owing to its fluttering, for I had not removed the wings, considerable difficulty in getting it into good position for swallowing—hence probably the rejection), but ate *Neptis agatha*, and after it, readily enough, *Eurytela dryope*, first, as usual, crushing each.

After the next seven small grasshoppers a *Papilio lyæus* was crushed a good deal and eaten with considerable deliberation. A *Papilio dardanus* was crushed and fairly readily swallowed (slightly more readily to all appearance than the *Papilio lyæus*), and a *Eurytela dryope* was persistently refused without tasting. The bird then accepted and crushed a *Leuceronia thalassina* ♂, but made no attempt to swallow it, her attention being diverted by a shrike (*Dryoscopus cubla*), which at that moment had struck up its loud "Trek-whi-wheoo" notes in a tree close by, and was being answered by the captive bulbuls. This went on for three or four minutes, the roller all the time craning forward and listening intently, with her head on one side and the uneaten *Leuceronia* in the point of her bill. The shrike now suddenly stopped its song and the roller, after listening for a second longer, once more woke up, and briskly resuming her usual position tasted well and this time definitely rejected the butterfly. She then obstinately refused to taste *Papilio lyæus*, but recognized, accepted, and ate a *Pyrameis cardui*, though obviously without appetite, ignored an *Antanartia schœneia* for a few moments, but changing her mind tasted it and, evidently fully approving, crushed and swallowed it. She next similarly refused a yellow *Catopsilia florella* ♀, but then taking it from the forceps played with it for some seconds, as usual tossing it into the air and catching it, and finally crushed and swallowed it. She played similarly with a ♂ *Catopsilia florella* and an *Antanartia* but ended by dropping each, ignored, then accepted, crushed and swallowed a *Precis cebrene*, and after it the *Antanartia*, both with evident lack of appetite but no sign of dislike, crushed well and held, crushed again and held, then half swallowed but brought up again, crushed and held, and finally tossed aside a *Papilio hippocoon* (she very evidently lacked the space rather than the will), persistently ignored a *Catopsilia florella* ♂, and crushed and tossed carelessly away into the air a *Hamanumida dædalus*, afterwards refusing it, as also a grasshopper, without tasting. Evidently, in so far as butterflies and Orthoptera were concerned, she was fairly replete. Nevertheless, on my offering her another large *Petascelis remipes* with a very strong smell, she accepted, crushed thoroughly (her peculiar manner in doing so reminding me of one's sensations in drinking a glass of particularly strong liqueur), and swallowed it, afterwards wiping her bill. I then offered a still larger though very similar bug, with, if anything, a still stronger smell and a quantity of bright blue matter exuding at the base of the thorax. The bird at once accepted it, and crushing it well, its breath once more almost taken away with the strength of its flavour, which it nevertheless obviously relished immensely, ate it. She then once more wiped her bill on the perch and refused obstinately to touch *Papilio hippocoon* or various favourite grasshoppers.

Ten minutes later she ignored *Catopsilia florella* ♂, just took in the point of her bill and tossed aside *Papilio lyæus*, *Papilio hippocoon*, and *Hamanumida dædalus*, and simply ignored various of her favourite grasshoppers.

Five minutes later she refused to touch *Papilio lyæus* and *Papilio hippocoon*.

Five minutes later she accepted, crushed and swallowed *Papilio lyæus* and two small grasshoppers, then refused without tasting a second *P. lyæus*, the *P. hippocoon*, and the *Catopsilia florella*, refused momentarily then accepted, crushed and swallowed *Hamanumida dædalus*, accepted, crushed very thoroughly and swallowed without hesitation the *hippocoon*, but repeatedly and with shakes of the head refused to have anything whatever to do with *Papilio lyæus* and the ♂ *Catopsilia*.

Three minutes later she readily ate the ♂ *Catopsilia*, tasted and rejected *Papilio lyæus*, readily ate a yellow ♀ *Catopsilia*, tasted and rejected a Lycoid Cetoniid (*Glycyphana balteata* var.), looking very bee-like with its wings spread (she did not crush *into* it at all—the beetle was hard—so I am doubtful whether it was properly tasted—no smell and no juices), and once more ate readily a ♂ and a yellow ♀ *Catopsilia*.

Twenty minutes later she crushed and readily ate *Papilio lyæus*, two small grasshoppers, and a second *Papilio lyæus*, tasted and at once rejected *Leuceronia thalassina* ♂ and *Papilio echerioides* ♀, accepted, crushed and held, then once more crushed and held, and finally rejected a *Papilio lyæus*.

I three times subsequently, at intervals of ten minutes, offered her *Papilio lyæus*, *Papilio echerioides* ♀, and *Leuceronia thalassina*, but she each time refused without tasting or just crushed them slightly and rejected them, without giving the slightest further indication as to their relative acceptability. The one indication that she *had* given points to *Papilio echerioides* ♀ being less acceptable than *Papilio lyæus* ♀, though not necessarily more so than *Leuceronia thalassina* ♂.

[SUMMARY :—

(1) *Grades* :—

	1. Coreid bugs.	
P. cardui.	2. *H. dædalus, P. cebrene*, a favourite grasshopper.	
	3. *C. florella* ♂ and yellow ♀, *A. schœneia, P. hippocoon.*	
P. dardanus ♂.	4. *P. lyæus.*	
	5. *L. thalassina* ♂.	*P. echerioides* ♀,
Glycyphana balteata.	6. *E. dryope.*	*A. serena*'s pupa (on taste), *N. agatha* (?).
	7. *Syntomis cerbera, M. agathina* ♂, *Osprynchotus flavipes, Lygæus*, red beetle.	

I think that the experiment on the whole justifies the above order, though some placings are naturally lower than others. Nothing was eaten to quite the same point of repletion as in the Coreid bugs. Additionally, *M. agathina* was probably at any rate not better than *M. campina*, or this than *N. agatha*, or *E. dryope* and *L. thalassina* than *P. dardanus* ♂; *P. dardanus* ♂ was eaten apparently more readily than *P. lyæus* once, but perhaps in consequence of stimulative influence by the latter; *A. schœneia* was probably not better than *P. cardui*, or yellow *C. florella* than *A. schœneia* or *P. hippocoon*, or *P. lyæus* than the latter or *C. florella*. *P. hippocoon* seemed very near or equal to *C. florella* and *A. schœneia*.

(2) *Note at the time*: The various occupants of grade 7 "were evidently more obviously unpleasant than the pupa of *Acræa serena*. This was treated exactly similarly by the kingfisher (*Halcyon cyanoleucus*). In both cases it was obvious that the birds were not at all sure whether it was fit to eat (at that stage) or not, and it seemed as though they must almost possess some special gauging power at the back of the throat (*cf.* experiments on swallows, *passim*). *Neptis agatha* was eaten after twenty-four grasshoppers later, showing that each of the above insects was decidedly nearer the rejected *agathina* in degree of unpleasantness than to *agatha*, and the fact that *M. agathina* was played with—the roller being probably nearly hungry enough to eat it—just before she rejected the *Acræa* pupa shows the same. I tasted a little of the juice exuding from the pupa after its first rejection and it was not markedly unpleasant, as in the case of the larva and imago—a *slight* poppy flavour, I thought. The ichneumon has great tenacity of life. After its crushings by the birds and an additional sharp crushing of the thorax by myself, it quickly recovered and moved about in most lively fashion. *Lygæus swynnertoni* (found feeding in numbers on *Vernonia livingstoniana*) is much more easily killed. Its extreme unwelcomeness, in spite of its practical lack of smell, while the large strong-smelling Coreids were eaten with relish in preference to the most palatable butterflies and grasshoppers, shows that the more typical *bug*-smells are in no way an indication of unpleasantness to the roller. The Coreids are literally in swarms on the oranges near the forest, sucking their juices and blackening their surfaces with their numbers—a spot visited almost solely by bulbuls. On the trees being shaken they fly or, rather, *drift* off slowly in crowds, numbers landing on the ground just round about. They are common, too, on tender terminal shoots of coffee, conspicuously exposed on the surface and usually several together. They are very sluggish in their general habits."]

Exp. 73.—*August* 22. The bird was very hungry. She readily ate, after crushing each, a *Terias*, a *Mylothris rueppelli* (sex not noted), and a ♂ *M. agathina*, rejected an *Acræa johnstoni* and an *Acræa esebria* (fulvous ♂), also a ♀ *Mylothris agathina*. She then readily ate a ♂ *Mylothris agathina*, again rejected the ♀ and once more readily ate a ♂; tasted and rejected *Lygæus swynnertoni* and the ichneumon (of yesterday's species), readily ate another *Mylothris agathina* ♂, tasted and rejected *Acræa serena*, and readily ate a *Terias*.

I now gave her a smallish grasshopper, after which she readily ate another *Terias* but crushed and at once rejected a ♂ *Mylothris agathina*. Then followed two more grasshoppers and another *Terias*, three more grasshoppers and another *Terias*, five more grasshoppers and yet another *Terias*, this one as readily as the rest. After six more grasshoppers she for some time refused to touch a *Terias senegalensis*, but finally, persuaded, took and swallowed it. Then two more grasshoppers, but I had evidently slightly overdone the feeding, for she now not only refused, then tasted, and rejected a *Terias*, but treated a *Belenois severina* exactly similarly.

Ten minutes later the bird readily ate the *Belenois* and refused the *Terias* most persistently without tasting. She then accepted doubtfully, crushed very slightly, and rejected a pupa of *Acræa buxtoni*.

Next, after eating a migratory locust, she persistently refused without tasting a second *Belenois*, but recognized and most readily ate a *Neptis agatha*.

After ten more small grasshoppers she obstinately refused to touch *Neptis agatha*, tasted doubtfully and rejected *Eurytela dryope*, refused without tasting *Leuceronia thalassina* ♂, crushed and readily ate a *Cyrestis camillus*, and after it the *Eurytela dryope* just rejected, refused to touch the *Neptis agatha*, but on my removing its wings crushed and definitely rejected it; crushed and readily ate *Eurytela hiarbas* and *Eurytela dryope*, tasted and rejected a wingless *Teracolus*, half-tasted, evidently viewing it with suspicion, a *Papilio angolanus* with one wing and refused to take it, then readily enough ate a *Eurytela dryope* and the *Papilio angolanus* with the wing removed.

After six more small grasshoppers she tasted and rejected emphatically both *Neptis agatha* and *Eurytela dryope*, refused to touch *Eurytela hiarbas* and readily ate *Papilio angolanus*, but also, immediately after it, the rejected *Eurytela dryope*.

Then two more grasshoppers and another *Eurytela dryope* and two more grasshoppers and yet another *Eurytela dryope*. After another four grasshoppers she crushed and rejected *Eurytela hiarbas* and *Eurytela dryope*, but ate the latter on its being reoffered, refusing, however, to have anything to do with the *Eurytela hiarbas*. The attendant had during the last few offerings been busying himself in distributing white ants to the various cages and the roller was unmistakably distracted in watching him. It seemed to me to account for this changeableness.

She now (the white ants having disappeared) readily ate a *Papilio angolanus* and a *Papilio demodocus*, crushed and rejected *Papilio angolanus*, refused persistently even to taste a wingless *Papilio echerioides* ♀, seeming to me to notice its very distinct bean-smell when brought close up, then crushed and rejected a *Papilio demodocus* and a *Papilio lyæus,* both ♀s. The latter was held in the bill longer and crushed more thoroughly, with an occasional pause, but it too was finally jerked away. She now refused persistently to again touch any of the four Papilios.

Fifteen minutes later, by lamplight, after at first ignoring them, she tasted all four in succession and at once rejected each.

Fifteen minutes later she crushed and ate the *Papilio demodocus* ♀ and the *Papilio angolanus*, refused, then tasted and rejected the *Papilio echerioides* ♀ (wingless), readily and without hesitation ate a *Papilio lyæus* (without wings and looking much like the *Papilio echerioides*), also a ♂ *Papilio demodocus*, crushed and rejected the *Papilio echerioides*, readily accepted and ate a wingless *Papilio lyæus*, and persistently refused without tasting and with signs of annoyance (shakes of head, retreating, etc.) the *Papilio echerioides*. She, I believe, recognized it by its smell, for by that dim light it seemed impossible to distinguish it from *Papilio lyæus.*

Five minutes later she accepted without hesitation and ate a wingless *Papilio lyæus* and refused, then suspiciously half-tasted, and rejected the *Papilio echerioides*, retreating when I reoffered it.

Three minutes later she accepted without hesitation and ate a *Papilio lyæus*, crushed and rejected the *Papilio echerioides*, crushed and readily ate a wingless *P. demodocus*, and then simply settled down for the night, refusing *lyæus*, both with and without wings. Both sexes of *lyæus* were used in this experiment, but the *Papilio angolanus* were all ♂s.

[SUMMARY:—

1. *P. lyæus*, on manner perhaps above } *Cyrestis camillus.*
2. *P. demodocus.* } 2. *P. angolanus.* } *Cyrestis camillus.*
3. *P. echerioides* ♀. } 2. *P. angolanus.*
3. *E. dryope* and *E. hiarbas.*
4. *N. agatha*, *Teracolus* (? ↓).
Pupa of *A. serena.* {
5. *B. severina*, *Terias.*
6. *Mylothris agathina* ♂.
7. *A. esebria* ♂, *A. johnstoni*, *M. agathina* ♀, *Lygæus swynnertoni*, and *Osprynchotus flavipes* (*Terias* and *Bel. severina* also above *A. serena*).

E. hiarbas was probably not liked more than *E. dryope*, perhaps less.]

Exp. 74.—*August* 23. After eating from the forceps a number of grasshoppers the bird refused absolutely to touch a *Terias*, but readily accepted and ate a *Neptis agatha.*

After ten more grasshoppers she readily ate another *N. agatha*, but after seven more grasshoppers she refused to touch a third, readily ate *Eurytela hiarbas* and refused for some time, then, becoming doubtless slightly hungrier, accepted and ate the *Neptis agatha.*

After six more grasshoppers she refused repeatedly and most obstinately even to taste *Neptis agatha*, but readily ate a *Eurytela dryope.*

After three more grasshoppers she once more ate a *Eurytela dryope* and refused a *Neptis agatha.* She then ate a locust with wings removed and again ate *Eurytela dryope*; then another locust with wings removed and yet another *Eurytela dryope.* After a third locust, however, with wings removed, she persistently refused *Eurytela dryope* and *Papilio echerioides*, both without wings, crushed very thoroughly and half swallowed *Papilio angolanus*, but brought it up again and rejected it after some further crushing. She then tasted and at once rejected the same *Papilio angolanus* with its wings removed, but crushed very thoroughly and ate a wingless *Papilio demodocus* ♀, again tasted and rejected the *P. angolanus*, afterwards refusing without tasting *Papilio echerioides* ♀ and *Papilio lyæus* ♀ (wingless).

Fifteen minutes later she crushed and rejected the *Papilio angolanus*, refused, then tasted and rejected *Eurytela dryope*, refused without tasting *Papilio echerioides* ♀ and *Papilio lyæus*, wingless ♀, crushed at great length *Papilio lyæus* with one wing attached and swallowed it, once more tasted and rejected *Papilio angolanus* and refused *Papilio echerioides* without tasting.

Thirty minutes later (by lamplight) she tasted and rejected the wingless *angolanus* ♂ and a *Eurytela dryope,* also a second ♂ *angolanus* with one wing, crushed and readily ate *Papilio lyæus* ♀, refused for some time, then tasted slightly and at once rejected the *Papilio echerioides* ♀, wingless.

Half an hour later she refused, then tasted and rejected *Papilio echerioides*, crushed and rejected *Eurytela dryope*, crushed and readily ate *Papilio angolanus* ♂, refused *Papilio echerioides* without tasting, crushed and rejected the next *Papilio angolanus* ♂ and a *Eurytela dryope*, but readily ate a *Papilio lyæus.* She then crushed and rejected both the *Papilio angolanus* and the *Papilio echerioides*, but readily ate, after crushing it, yesterday's white *Catopsilia*-like butterfly, still quite lively.

[Summary :—

1. *Papilio lyæus* ♀, *Papilio demodocus* ♀, and the *Catopsilia*-like Pierine.
2. *Papilio angolanus* ♂.
3. *Eurytela dryope, Eurytela hiarbas.*
P. echerioides ♀. { 4. *Neptis agatha.*
5. *Terias.*

There was nothing to show whether the *Papilio echerioides* was more or less disliked than the two species of *Eurytela.*]

Exp. 75.—*August* 29. The bird refused a *Terias*, but on my continuing to hold it to her tasted it very slightly, as though merely to humour me, and drew back without tasting it. She then readily ate *Neptis agatha* and a migratory locust, crushed and at once rejected *Papilio angolanus* with all its wings, readily ate *Leuceronia argia* ♀ and *Eurytela dryope*, crushed and rejected *Papilio angolanus* with two wings, crushed doubtfully but finally threw back into her throat and swallowed one that I had stripped of wings, refused, then barely tasted and threw away the next, crushed and nearly swallowed a fifth, but, changing her mind, threw it away and shook her head and readily ate, after crushing it, a *Eurytela dryope.*

Three minutes later she crushed well with a doubtful air and swallowed a *Papilio angolanus* with one wing, refused the next for some time but finally took it from me with an air of irritation, crushed it slightly and threw it away (no wing), obstinately refused the next (with one wing), also the next, then tasted it very slightly and rejected it, after that persistently refusing to have anything to do with it.

She now ate a *Neptis agatha* with, I thought, disinclination, making as though to reject it, but changing her mind and tossing it carelessly back into her throat, refused, then tasted perfunctorily and rejected a *Terias*; refused for a moment, then accepted and readily enough ate a *Papilio lyæus*, readily accepted and ate a *Papilio demodocus*, refused a *Papilio angolanus*, then barely closed her bill on it and withdrew with a shake of the head and would have nothing further to do with it.

There was now a delay of, roughly, five minutes while I sallied out to catch a

Neptis agatha, of which there were several in the garden. It was readily accepted and eaten, as was also a *Papilio angolanus* with one wing. The next two *Papilio angolanus* were tasted and rejected (the first without wings, the second with two).

Again five minutes were spent in securing a *Neptis agatha*, and I gave the bird two small grasshoppers to make up for any increase of appetite that the delay might have caused. She then refused for a long time, without tasting, both *Neptis agatha* and wingless *Papilio angolanus*, but finally leant forward and cautiously tasting the tip of one of the latter's antennæ at once drew back with a shake of the head. She then crushed well and swallowed the *Neptis agatha* and tasted and rejected and afterwards refused obstinately to have anything to do with a *Papilio angolanus*.

She then battered and ate with enjoyment two large migratory locusts, refused even to touch *Neptis agatha* and *Papilio angolanus*, tasted and rejected *Eurytela dryope* and *Leuceronia argia* ♀, and refused without tasting *Papilio demodocus*.

Five minutes later she crushed and rejected *Leuceronia argia* ♀, crushed well and tossed away a *Papilio demodocus*, and refused persistently without tasting *Papilio lyæus*.

Five minutes later she refused without tasting *Leuceronia argia* ♀, *Papilio demodocus*, and *Papilio lyæus*.

Five minutes later again she readily ate *Papilio demodocus*, continued for a few minutes to refuse *Leuceronia argia* but finally accepted, crushed and ate it readily.

[Summary:—(1) *Papilio angolanus* was placed much lower than on the 23rd, below *Neptis agatha* instead of above *Eurytela dryope*. "It will be interesting to see whether *Papilio echerioides* will still be placed below *angolanus*."

(2) *Grades*:—

N. agatha. { 1. *P. demodocus*, possibly on manner but not certainly above
E. dryope. { 2. *L. argia* ♀.
3. *P. angolanus*, above, one would judge,
4. *Terias*, though this is not certain.]

Exp. 76.—*August* 30. Hungry, refused to touch an *Acræa igola*, red ♀, with wings, tasted and at once rejected *Planema aganice* ♀ with one wing and an *Acræa anemosa* without, crushed very thoroughly and with a doubtful air a wingless *Danaida chrysippus*, then threw it away; refused an *Acræa asema* with wings, refused, then half-tasted and rejected a *Nychitona medusa*, looked hard at an *Acræa johnstoni* with all its wings (doubtless suspicious of the *Acræa*-body), both from above and from below, then tasted and rejected it, refused persistently without tasting *Mylothris yulei* with one wing, refused for a moment, then tasted and rejected *Mylothris agathina* ♂, readily ate a *Terias*, refused *Mylothris agathina* ♂ once more without tasting, but readily ate another *Terias* and a *Papilio angolanus*.

I now gave her three small grasshoppers. After eating those she refused a *Terias*, crushed and rejected *P. angolanus*, refused, then changing her mind, crushed and ate the *Terias* (*T. senegalensis*), refused, then tasted and rejected *Papilio angolanus*, refused persistently a *Terias senegalensis*, recognized and eagerly accepted and ate a *Neptis agatha*, and once more refused obstinately without tasting the *Terias* and the *Papilio*.

Fifteen minutes later she refused but, changing her mind, ate *Papilio angolanus*, refused similarly and then ate a *Terias*, then (this time readily enough) ate another *Terias* and a second *Papilio angolanus*, two small grasshoppers, and yet another *Papilio angolanus*. I had, unfortunately, no *Terias* left to offer, but the experiment up to this point convinced me sufficiently that the bird regarded *Papilio angolanus* as on about the same level as *Terias*.

She then ate seven small grasshoppers, refused, then twice crushed and rejected *Neptis agatha*, tasted and rejected, but then changing her mind ate *Eurytela dryope* and, with apparent relish, after crushing it, *Papilio antheus*.

An interruption of twenty minutes now occurred. On my return the bird readily ate seven small grasshoppers and a *Neptis agatha*, a small and a large grasshopper, and another *Neptis agatha*. After seven more small grasshoppers, however, she refused obstinately and repeatedly to touch *Neptis agatha* or *Eurytela dryope*, crushed well and rejected *Papilio lyæus*, crushed and readily ate *Papilio antheus*, crushed and rejected, but on my reoffering it ate *Papilio lyæus*, listlessly, however, as though quite disinclined for food, refused the next without tasting, but, finally, yielding to my importunity, tasted and rejected it; obstinately refused *Papilio demodocus*, refused, then crushed and rejected *Papilio dardanus* ♂, and obstinately refused to touch either *Papilio antheus* or *Papilio lyæus*.

Five minutes later she refused to touch *Papilio lyæus*, *Papilio demodocus*, *Papilio antheus*, and *Papilio dardanus* ♂, but readily accepted and ate a *Catopsilia florella*, afterwards, her appetite doubtless stimulated by the eating of the Pierine, accepting and eating *Papilio lyæus* after much crushing and with evident disinclination. She then crushed slightly and tossed carelessly up into the air the ♂ *Papilio dardanus*, crushed very thoroughly and swallowed, though once more with disinclination, the *Papilio demodocus*, and refused persistently to touch *Papilio antheus*, *Papilio dardanus* ♂, *Papilio lyæus*, and *Catopsilia florella*.

Five minutes later she once more refused all four.

Five minutes later she readily enough ate *Catopsilia florella* and *Papilio antheus*, each as usual after crushing, refused, then accepted, crushed long and doubtfully, and finally ate *Papilio dardanus* ♂, refused obstinately to touch *Papilio lyæus*, half-tasted and refused to take *Papilio dardanus* ♂, and once more persistently refused without tasting *Papilio demodocus* and *Papilio lyæus*.

Three minutes later she crushed well and ate *Leuceronia argia* ♀ and refused without tasting *Papilio demodocus*, *Papilio lyæus*, *Leuceronia thalassina* ♀, and *Catopsilia florella*, but ate with disinclination one small grasshopper, refusing utterly to touch a second. The first was held for quite a long time in the point of the bill before being swallowed.

She then refused, but changing her mind tasted and, reassured, at once crushed well and swallowed *Salamis anacardii*, and after it, again after thorough crushing, *Papilio dardanus* ♀ f. *hippocoon*. She then crushed well and tossed away *Papilio antheus* and persistently refused without tasting *Salamis nebulosa*, *Salamis anacardii*, *Precis natalensis* ⊙, *Pyrameis cardui*, and *Precis cebrene*, finally, however, changing her mind and eating the *Precis cebrene* and leaning forward to the *Pyrameis*, which I reoffered, but withdrawing without tasting it, evidently utterly replete. A second *Precis cebrene* was now persistently refused without tasting.

After a further interruption of nearly half an hour I continued the experiment by lantern-light. The bird now readily ate *Eurytela dryope*, *Neptis agatha*, *Syntomis cerbera*, and seven small grasshoppers, refused obstinately to touch *Neptis agatha*, crushed and rejected *Eurytela hiarbas*, refused *Eurytela dryope* without tasting, crushed and rejected *Leuceronia thalassina* ♀ and *Papilio lyœus*, barely closed her bill on *Papilio antheus* and refused to take it, refused without tasting *Salamis anacardii* and *Catopsilia florella*, refused, then tasted and, evidently attracted, crushed and ate *Precis natalensis* ⊙ f., similarly refused, then crushed and ate *Precis archesia* ⊙ f., accepted and ate without hesitation *Precis antilope*, refused for a time (probably taking it for *Eurytela dryope*), then tasted slightly and, reassured, readily ate *Precis elgiva*, refused obstinately without tasting *Precis tugela*, *Precis cebrene*, and *Pyrameis*, but, attracted by *Salamis nebulosa*, leaned forward, crushed and swallowed it, and after it three *Salamis anacardii* with the greatest relish. The last was held for some time before being swallowed, the bird being evidently replete. She now obstinately refused to touch *Precis cebrene* and *Pyrameis cardui*.

Five minutes later she refused to touch *Precis elgiva*, crushed slightly and tossed away *Precis tugela* and *Hamanumida dœdalus*, and once more obstinately refused *Precis cebrene* and *Pyrameis cardui*.

Ten minutes later I reoffered all four of the above butterflies as also a *Precis archesia*, a brown *Crenis*, and a usually highly-acceptable grasshopper, but the bird simply ignored them. An hour later she readily ate *Eurytela dryope*, *Neptis agatha*, and a *Syntomis cerbera*, looking doubtful after the latter, however.

[SUMMARY:—(1) *Note*: "*Papilio angolanus* was roughly but unmistakably placed on a level with *Terias*, whether just below or just above it is impossible to be sure, but possibly the former. In either case the difference must be very small indeed. Both were once more definitely preferred to *Danaida*, various Acræinæ, *Leptosia*, and *Mylothris*, as was *Neptis agatha* to the *Terias* and the *Papilio*, and in their turn *Eurytela dryope* to the *Neptis* and *Papilio lyœus*, and *Papilio antheus* to the *Eurytela*. Between *Papilio lyœus*, *Papilio antheus*, *Papilio demodocus*, and *Papilio dardanus* ♂ there is, I believe, no great difference. *Leuceronia argia* ♀, as once or twice before, was taken up to a very late stage and in apparent equality to the pleasanter Papilios or even *C. florella*."

(2) *Grades*:—

1. *Salamis* spp. 2.
P. tugela. 2. A favourite grasshopper, *P. cebrene.*
P. natalensis ⊙ f.
Pyr. cardui. 3. *C. florella.* *L. argia* ♀.
P. demodocus. 4. *P. antheus.* (*L. thalassina* ♀
P. dardanus ♂. 5. *P. lyœus.* and *E. hiarbas*? ↓.)
6. *E. dryope.*
7. *N. agatha.*
8. *Terias*, *P. angolanus.*
9. *D. chrysippus*, on manner above *A. asema*, *N. medusa*,
10. *A. igola*, red ♀, *P. aganice*, *A. johnstoni*, *M. yulei*,
A. anemosa. *M. agathina* ♂.

P. dardanus ♀ f. *hippocoon* was placed in grade 1, but possibly as the result of special stimulation. Still it must be very high grade (unless, indeed, the eatings of *Syntomis* show that the lowest grades can take high places as the result of stimulation).

P. archesia ⊙ f., *P. antilope*, and *P. elgiva* were eaten up to *cebrene*-refusing point, but immediately after a *P. natalensis* ⊙ f., which may, of course, have stimulated.]

Exp. 77.—*August* 31. Hungry; refused with a shake of the head, evidently remembering it from last night, a *Syntomis cerbera*, but on my continuing to offer it tasted and rejected it. These moths are present in special numbers on the flowers of a *Vernonia podocoma* standing alone in the open pasture-land. Readily ate a *Terias*, crushed and rejected a second Syntomid, but readily enough ate a *Mylothris* (like *rueppelli*, but with paler orange), again tasted, this time slightly, another *Syntomis* and readily ate a ♂ *Mylothris agathina*, crushed and rejected a *Mylothris agathina* and a fourth *Syntomis*, refused absolutely to even touch a *Nychitona medusa*, crushed and at once rejected a blister beetle, *Mylabris*, in the act of exuding its yellow juices, and thereafter refused obstinately and with shakes of the head to taste it again.

She then eagerly ate two small grasshoppers, tasted and rejected, then refused to touch *Mylothris agathina* ♂, but readily ate a large pale *Terias*.

After two more small grasshoppers she readily ate a *Papilio angolanus* and after six more a second, this time after much more deliberate crushing; crushed and rejected, then refused without tasting, an *Aletis monteironis* with Myrmeleonid-like smell, came up eagerly but a little doubtfully to take a *Phymateus viridipes* with an unusually large supply of froth from behind the last pair of legs, but showed distinct suspicion of it on its suddenly displaying its brilliantly-coloured wings. She seized it, nevertheless, but the wings were greatly in her way and, after one or two ineffectual attempts to get into position for battering, she threw it away. I reoffered it, and this time the bird obtained a better grip, but after crushing it somewhat again rejected it. I now removed the wings and the bird crushed and battered it and seemed greatly inclined to eat it, but in the end once more abandoned it.

Twenty minutes later she twice refused, but then changing her mind crushed and readily ate a *Terias brigitta* (?), and crushed and rejected with marked dislike the *Aletis monteironis*.

She now suddenly flew down, seized the *Phymateus* that was moving about on the bottom of the cage, and returned with it to her usual perch, where she crushed and battered it to a thorough pulp, the abdomen coming off in the process. Finally, the thorax, after two or three ineffectual efforts, each followed by further battering, was swallowed, but the bird refused to have anything to say to the abdomen which I extracted and offered through the bars.

Three minutes later she accepted it, crushed it well, and twice nearly swallowed it, the second time getting it halfway down her throat. It was brought up again however, and rejected. On my twice reoffering it, it was each time taken and at once flung away, and after that the bird obstinately refused to have anything to do with it. She then refused but, on my persisting, accepted, crushed, and rejected an *Ypthima*, accepting it, however, when reoffered and swallowing it doubtfully. She afterwards shook her head. *Neptis agatha* was, however, accepted eagerly and at once eaten.

The bird now ate eagerly three smallish grasshoppers and another *Neptis agatha*, followed by a somewhat large grasshopper, and then refused *Neptis agatha* persistently without tasting, readily ate *Eurytela dryope*, and again refused *Neptis agatha*, but ate *Eurytela hiarbas* and after it two *Neptis agatha.*

Ten minutes later she ate two grasshoppers, refused, but at once changing her mind accepted and ate *Neptis agatha*, three more grasshoppers, then refused *Neptis agatha* and *Neptis saclava*, but attracted by the latter's fluttering (the underside only was shown in order to distinguish it from *agatha*) afterwards accepted, crushed, and swallowed it.

After three more small grasshoppers she readily ate a *Neptis agatha*, after three more she refused to touch *Neptis agatha* but readily ate *Eurytela dryope*; after three more she again refused *Neptis agatha* but ate another *dryope*; after two more she once again refused *Neptis agatha*, tasted and rejected *Eurytela dryope*, but on my reoffering it ate it but refused *agatha.* She now ate two more grasshoppers, and finally and persistently refused to touch *Eurytela dryope* or *Papilio echerioides* ♀.

A delay of five minutes now occurred, after which (by lamplight) *Eurytela dryope* and *Papilio echerioides* ♀ were once more refused, *Charaxes ethalion* accepted and readily eaten, *Leuceronia thalassina* ♀ crushed and rejected, *Papilio antheus* ♀ crushed very thoroughly and eaten, *Papilio dardanus* and *Papilio demodocus* persistently refused without tasting, *Papilio lyæus* well crushed and rejected, but *Caprona pillaana* and a brown *Crenis* crushed and readily eaten. The bird now refused to touch *Papilio echerioides*, *Hamanumida dædalus*, *Precis cebrene*, *Catopsilia florella*, and *Pyrameis cardui*, simply settling down determinedly for the night. This refusal was repeated twenty minutes later.

[SUMMARY :—(1) *Grades* :—

C. ethalion.	1. *Caprona pillaana.* 2. *P. lyæus* and *P. antheus.*	*E. hiarbas.*
P. dardanus ♂. *P. demodocus.* *L. thalassina* ♀. *P. echerioides* ♀.	3. *E. dryope.* 4. *N. agatha.* 5. *Ypthima*, probably not much above *Phymateus.*	
	Terias, probably not much or at all below *Phymateus.* *P. angolanus* ? ↑.	
	6. *M.* near *rueppelli* and *M. agathina* ♂. 7. *Syntomis cerbera.*	*M. agathina* ♀, *N. medusa*, *Mylabris*, *Aletis monteironis.*

The *Crenis* was eaten (possibly under stimulation from the *Caprona*) up to *cebrene*-refusing point. I have placed *P. lyæus* and *P. antheus* over their two pleasanter congeners here simply on manner. The difference is probably slight.

(2) *Note*: "*Aletis monteironis* ♂, which from its slow flight, smell, and flaunting habits I had supposed to be probably very low-grade, proved actually to be so. The *Phymateus* was placed rather lower than on previous occasions (on a level with *Terias*?). The individual used had a large supply of froth that bubbled out freely from behind its posterior pair of legs. The smell is simply that of strong cocoa and not nearly so objectionable, from a human point of view, as that emitted by the dark dull blue *Phymateus*. *Papilio echerioides* (♀, the last one offered was a ♂, but only the underside was shown) was remembered with some dislike, *Papilio antheus* again appeared to be slightly preferred to *Papilio lyæus*, and *Caprona pillaana* was placed in 'grade 1' of the experiment."

Exp. 78.—*September* 1. Crushed and readily ate *Mylothris agathina* ♂, tasted and rejected *Acræa buxtoni* ♂, *Syntomis cerbera*, and *Acræa doubledayi* ♀. She then ate six small grasshoppers and refused to touch *Mylothris agathina* ♂ or a *Terias*. After six more small grasshoppers she again refused to touch *Terias*, but, after thorough crushing, ate a *Papilio angolanus* and, very readily, a *Belenois severina*, again crushing an *angolanus* well and swallowing it. After six more grasshoppers, she once more accepted and ate *Papilio angolanus* and obstinately refused to touch *Terias*; tasted slightly and rejected, then persistently refused *Mycalesis campina*, and obstinately refused the next *Papilio angolanus* as also *Neptis agatha*; refused, then changing her mind crushed *Papilio lyæus* well and swallowed it, tasted and rejected *Papilio angolanus* and refused *Eurytela dryope* absolutely.

Twenty minutes later she refused *Neptis agatha* without tasting, readily ate *Eurytela dryope*, refused *Neptis agatha* once more, readily ate *Papilio angolanus*, yet again refused *Neptis agatha* and *Mycalesis campina* without tasting, but, brisking up suddenly, crushed well and ate *Pseudacræa lucretia* and *Neptis agatha* and refused *Terias* without tasting. After two grasshoppers, she once more readily ate *Eurytela dryope*, crushed and rejected *Papilio angolanus*, readily ate, after tasting it well, ♀ *Papilio echerioides*, refused for a long time without tasting, but finally accepted and ate *Eurytela dryope*, tasted and rejected *Mycalesis campina*, and refused *Neptis agatha* without tasting, finally, however, accepting and eating it. She then ate six grasshoppers and *Eurytela dryope*, six more grasshoppers, and crushed and rejected *Eurytela dryope*, crushed well and ate *Leuceronia argia* ♀, refused without tasting *Eurytela dryope*, crushed very thoroughly and ate *Papilio dardanus* ♂, but rejected, after tasting it, the next; refused obstinately, without tasting them, *Papilio demodocus* ♀ and *Herpænia eriphia*, crushed *well* and rejected *Papilio lyæus*, refusing it on its being reoffered; crushed thoroughly and finally ate *Catopsilia florella*; refused *Precis elgiva* without tasting (taking it for *Eurytela dryope*?), crushed thoroughly and readily ate *Charaxes neanthes* and a *Zeritis*; tasted slightly and rejected *Herpænia eriphia*; refused, then crushed very thoroughly and ate a *Henotesia perspicua*, and readily ate a *Precis natalensis* ⊙ f. She then refused obstinately to eat a *Precis clelia* and a *Precis cebrene*, crushed and ate two very small grasshoppers, holding each for a very long time before finally swallowing it and absolutely and repeatedly refused to touch another, or a *Precis cebrene* or *Pyrameis cardui*. A little later she once more refused grasshoppers, *Precis cebrene*, and *Pyrameis cardui*.

[SUMMARY:—

1. Small grasshoppers, above *Precis cebrene* and *P. clelia* and ∴ prob. above
2. *P. natalensis* ⊙ f., *C. neanthes*, *Charaxes florella*.
3. *P. lyæus* in manner above
4. *P. dardanus* ♂ and, say, *P. demodocus* ♀, *L. argia* ♀.
5. *Eurytela dryope* and *Papilio echerioides* ♀, } *P. lucretia* ? ↑.
6. *P. angolanus* about here. }
7. *Neptis agatha*, perhaps above
8. *Mycalesis campina*. *Terias*, *M. agathina* ♂, and (not *above* it) *A. serena*, *S. cerbera*, and *A. doubledayi* ♀. *B. severina* was placed above *Terias*.]

Exp. 79.—Several hours later—plenty of food meantime in cage—a *Terias* was persistently refused but a *Papilio angolanus* readily eaten. The bird then ate six small grasshoppers; refused, then tasted very slightly and rejected in turn *Belenois severina* and *Papilio angolanus*, obstinately refused *Terias* and a second *Papilio angolanus* without tasting, but readily ate *Neptis agatha*. Ten minutes later she tasted very slightly and rejected *Mycalesis campina*, and refused without tasting *Papilio angolanus*. In offering the latter insect I had brought it close up to the bird's bill, which it now grasped, crawling up over the roller's head. The bird shook it off, caught it as it fell, crushed it well, and rejected it. She then refused to touch *Belenois severina*. After four more grasshoppers, she tasted very slightly and refused to take *Neptis agatha*, but readily ate a *Eurytela dryope*, and after it she rejected *Neptis*. She then ate four more small grasshoppers, tasted and rejected *Neptis agatha*, *Eurytela dryope*, *Papilio echerioides* ♀, and *Herpœnia eriphia*, but readily ate a ♂ *Leuceronia argia*, refused without tasting a *Pinacopteryx* (like ♂ *agathina*, but size of *yulei*), readily ate a ♂ *Papilio dardanus*, and tasted well and rejected the *Pinacopteryx*.

Fifteen minutes later she readily ate *Eurytela dryope* and *Neptis agatha*, a small grasshopper and one more *Neptis agatha*, three more grasshoppers, and a *Papilio angolanus*. After seven more grasshoppers, however, she tasted slightly and rejected *Neptis agatha*, readily ate a *Eurytela dryope*, refused without tasting *Neptis agatha*, crushed and readily ate the ♀ *Papilio echerioides* and immediately afterwards ate not only the hitherto rejected *Neptis agatha* and two *Papilio angolanus*, but a *Belenois severina* and, after refusing a *Terias*, quite a number of small grasshoppers. Fluctuations of appetite, the result usually of stimulation, are not infrequent, but a jump such as this, from pudding to soup, involving practically a recommencement of her nearly completed meal, was rather unprecedented.

In the evening, by lantern-light, she readily ate five small grasshoppers, crushed and rejected *Neptis agatha* and *Eurytela dryope*, and refused, then tasted slightly and rejected the *Pinacopteryx*, without wings. Five minutes later she crushed well and rejected with obvious dislike the *Pinacopteryx* (the body was now lost, so could not be reoffered), refused *Neptis agatha* without tasting, crushed and rejected *Eurytela dryope*, ate readily *Herpœnia eriphia* (but it had previously fallen in water, so tasting not necessarily trustworthy), and refused without tasting *Papilio demodocus*.

[SUMMARY :—

1. *Leuceronia argia* ♂, *Papilio dardanus* ♂.
Herpœnia eriphia, *Pinacopteryx*. { 2. *Eurytela dryope*, *P. echerioides* ♀.
3. *Neptis agatha*.
4. *P. angolanus*, } *Belenois severina*.
5. *Terias*. }

If its tasting after falling in the water is to be relied on, *H. eriphia* would form a grade intermediate between the above grades 1 and 2.

The *Pinacopteryx* was, at any rate, probably not *above P. dardanus* ♂.]

Exp. 80.—*September* 2. Distinctly hungry, readily ate *Mylothris agathina* ♀, refused with many shakes of the head *Nychitona medusa*, tasted it and flung it away on my pressing it on her, tasted and rejected *Nyctemera leuconoë*, refused without tasting an *Aletis monteironis*, readily ate *Mylothris rueppelli* ♀, crushed thoroughly and finally rejected with evident dislike a ♀ of the common blue-and-yellow Ichneumon (*Osprynchotus flavipes*) that so often enters houses, crushed and after hesitation ate *Mylothris yulei* ♀, accepted the Ichneumon doubtfully and, after subjecting it to very prolonged crushing, half swallowed it, again crushed it thoroughly and ended by swallowing it finally, then crushed and rejected *Nyctemera leuconoë*, *Aletis monteironis* ♀, *Syntomis cerbera*, and *Planema aganice* ♀. She now, after five small grasshoppers, refused obstinately to touch *Terias senegalensis*, but readily ate a *Papilio angolanus* and a *Belenois severina*. After seven more grasshoppers it again refused to accept the *Terias*, but after crushing it well ate a *Papilo angolanus*. Then followed a grasshopper and another *Papilio angolanus*, a second grasshopper and again a *Papilio angolanus*, two more grasshoppers and three separate rejections after tasting of *Papilio angolanus*. *Belenois severina* was then refused persistently without tasting, a *Neptis agatha* barely tasted and rejected, a *Papilio angolanus* (one of the rejected ones) crushed rather doubtfully and eaten, a *Neptis agatha* refused, then definitely crushed and rejected, a *Belenois severina* tasted well and rejected, then refused persistently; a *Papilio angolanus* tasted and rejected but eaten on being reoffered and a *Neptis agatha* refused without tasting, but then tasted well and rejected. The bird now for a minute or two refused to touch *Papilio echerioides* ♂, then barely closed the point of her bill on it and refused to take it, again refused it without tasting, and finally accepted, crushed it well, and ate it without further hesitation. She then refused *Neptis agatha*, but changing her mind accepted and ate it, refused a second, but, once more changing her mind, ate it; refused repeatedly and emphatically to have anything to do with a *Belenois severina*, but readily ate a *Papilio angolanus*.

[SUMMARY :—

(*a*) 1. *P. angolanus*.
2. *N. agatha*, *B. severina*, *T. senegalensis*.

(*b*) 1. *Mylothris rueppelli* ♀.
2. *Nychitona medusa*, *Nyctemera leuconoë*, *Aletis monteironis*, each probably not appreciably *better* than *M. agathina* ♀ or (with *Syntomis cerbera* and *Planema aganice* ♀) than *M. yulei* and *Osprynchotus flavipes*.

(*c*) 1. *Mylothris yulei.*
2. *O. flavipes.*

The following note is interesting as showing my impressions at the actual time of carrying out the above few experiments :—

Note at time: "The following represents my present idea of some of the roller's preferences :—*Papilio antheus*; *Papilio lyæus* and *demodocus*; *Papilio dardanus* ♂; *Leuceronia argia*; *Leuceronia thalassina* ♂; *Papilio echerioides*; *Papilio angolanus* and *Eurytela dryope*; *Eurytela hiarbas*; *Neptis agatha.* The semicolons represent distinctions that are very small and all probably of about equal value. *Papilio angolanus* may, however, yet go higher; it is extraordinary that after having dropped in the roller's estimation to the level of *Terias* it should have so quickly crept up to the neighbourhood of *Eurytela dryope.*"]

Exp. 81.—*September* 3. Crushed and rejected *Aletis monteironis*, *Syntomis cerbera*, *Acræa asema*, and *Danaida chrysippus*, but ate a *Terias* and, after a large number of small grasshoppers, persistently refused to touch *Neptis agatha* and *Eurytela dryope*.

Fifteen minutes later she tasted and rejected *Neptis agatha*, hesitated to taste a wingless *Papilio echerioides* ♂, looking bedraggled and macerated after its crushing by the Kingfisher, then barely closed her bill on it and withdrew with a shake of the head and refused even to taste *Eurytela dryope*.

Half an hour later, after four or five grasshoppers, she tasted and rejected the ♂ *Papilio echerioides*, readily ate *Neptis agatha*, and once more tasted and rejected the *Papilio echerioides*. She then ate ten small grasshoppers, the last with disinclination, and refused the next; tasted and at once rejected *Neptis agatha*, crushed well and threw away *Papilio demodocus* ♀, crushed and readily ate a *Papilio policenes*, and refused a *Papilio lyæus*. On my continuing to hold it to her, however, she took it, crushed it for a long time, once or twice nearly rejecting it, but finally swallowed it. She then once more crushed and rejected *Papilio demodocus* ♀ and a second *Papilio lyæus*, but readily ate, after crushing each, *Salamis nebulosa*, *Salamis anacardii*, and *Papilio hippocoon*, then leant forward and half tasted *Papilio demodocus* ♀ but withdrew without taking it from the forceps. She then refused but, changing her mind, accepted and ate *Melanitis leda*, tasted very slightly and with suspicion and refused to take a *Henotesia perspicua*, refused persistently and with vehement shakes of the head a rather rubbed and battered *Precis elgiva*, which was perhaps taken for *Eurytela dryope*, but readily accepted and ate, though with obvious lack of appetite, *Precis archesia*, and similarly accepted, held for a time, and finally crushed and ate *Precis madagascariensis*.

Five minutes later she refused without tasting *Neptis agatha*, made as though to take but suddenly drew back from a *Rhopalocampta forestan* (spots) without smell. On my continuing to offer it she crushed it and threw it away, afterwards refusing persistently to touch it again. She then readily ate *Pyrameis cardui* and *Precis cebrene*, again tasted and rejected the *Rhopalocampta*, readily ate a *Pyrameis cardui* and a *Precis clelia*, refused the *Rhopalocampta* without tasting but, on my removing the wings, accepted it, still with some suspicion or disinclination, crushed it well and swallowed it. She then refused for a second but then accepted and ate *Precis cebrene*, refused *Precis elgiva* for a time with emphatic shakes of the head, undoubtedly taking it for *Eurytela dryope*, but finally tasted it cautiously and evidently approving of it accepted, crushed, swallowed it. She then refused *Precis cebrene*, grasshoppers, &c.

[SUMMARY :—

(a) 1. *Terias.*
2. *A. monteironis*, *S. cerbera*, *A. asema*, *D. chrysippus.*
(b) 1. *P. policenes*, *S. nebulosa*, prob. *M. leda*, *P. archesia* ⊙ f.
H. perspicua, *P. elgiva* (or whatever it was taken for). { 2. *P. demodocus* ♀, *P. lyæus* (latter, at any rate, prob. not *better* than *policenes*).
3. *N. agatha.*
4. *P. echerioides* ♂.
(c) 1. *P. cardui.*
2. *N. agatha*, *Rh. forestan.*

P. cebrene, *P. clelia*, *R. forestan* itself, and *P. elgiva* were eaten to *cebrene*-refusing point, and *S. anacardii* and *P. hippocoon* in preference to *lyæus*, and *lyæus* in preference to *demodocus*, *cebrene* and *clelia* to *forestan*, but in all these cases, as in the eating of *P. madagascariensis* and of *P. elgiva*, special stimulation has to be suspected. Still *P. elgiva* and *P. madagascariensis* were both, in particular, eaten very high. The crushed state of the *P. echerioides* may have had to do with its rejection, but I do not feel sure that this is likely.]

Exp. 82.—*September* 7. Ate a very large grasshopper and a number of termites, then obstinately refused *Terias brigitta*, readily ate *Papilio angolanus* and *Neptis agatha*, and once more obstinately refused the *Terias*. She then ate six small grasshoppers, refused to touch the *Terias*, but again readily ate *Neptis agatha* and *Papilio angolanus*. After six more small grasshoppers she obstinately refused even to taste *Neptis agatha*, ate *Papilio angolanus* slowly and doubtfully or with disinclination, refused *Neptis agatha* and *Eurytela dryope*, crushed and rejected *Papilio angolanus*, and once more persistently refused *Eurytela dryope*.

Fifteen minutes later she refused, then tasted slightly and rejected *Neptis agatha*, readily ate *Papilio angolanus*, again refused to touch *Neptis agatha*, but crushed and ate *Papilio echerioides* ♂, *Eurytela dryope*, and, doubtfully, the *Neptis agatha* just refused; refused for a time, then tasted and rejected a *Terias* and readily ate a *Byblia*. After three small grasshoppers she tasted well and rejected *Neptis agatha*, crushed and readily ate a ♀ *Papilio echerioides*, again crushed and rejected *Neptis agatha*, readily ate a *Papilio angolanus*, but rejected the next after crushing it; tasted and rejected *Neptis agatha*, tasted and rejected a ♂ *Papilio echerioides*, refused rather obstinately but finally crushed and rejected *Eurytela dryope*, refused, then crushed and readily ate *Leuceronia argia* ♀.

[SUMMARY :—

(1) *Note*: "This experiment appears to place *Papilio angolanus* and *Papilio echerioides* on roughly the same level, probably that of *Leuceronia thalassina*, that is to say if anything just above *Eurytela dryope* and just below *Leuceronia argia*. *P. echerioides* dead."

(2) *Grades*:—

1. *L. argia* ♀.
Byblia 2. *P. angolanus* and *P. echerioides* ♂ & ♀. *E. dryope.*
3. *N. agatha.*
4. *T. brigitta.*]

Exp. 83.—*September* 8. In morning, hungry, crushed and ate a freshly-caught *Acræa rabbaiæ*, tasted and rejected *Acræa* sp., crushed very thoroughly, nearly swallowed and finally rejected *Planema aganice* ♀, lively but rather long caught and juiceless. She then tasted a wingless *Danaida* and three times in succession rejected it with an air of suspicion. The *Acræa rabbaiæ* was unmistakably liked the best, and next to it came the *Planema*, showing that at all events without its "poppy" secretion, it is not obviously very violently unpleasant [wrong order for this deduction—though impression at time must count—and *aganice* incident perhaps due to stimulation by *rabbaiæ*].

Later in the day, once more fairly hungry, she hesitated over, then accepted, crushed, and swallowed a *Terias brigitta*, ate six or seven small grasshoppers, absolutely refused to touch either a *Terias brigitta* or a *Neptis agatha*, but readily ate a *Papilio angolanus*; ate three more grasshoppers and another *Papilio angolanus* and three more and a third *angolanus*. After the next three grasshoppers she absolutely refused to have anything to do with a *Papilio angolanus* and tasted and at once rejected *Papilio echerioides* ♂. Three minutes later she crushed and rejected *Papilio angolanus* and refused without tasting *Papilio echerioides* ♂; tasted and rejected *Eurytela dryope* and refused without tasting *Eurytela hiarbas*. Three minutes later she crushed well and ate with no sign of dislike a *Pinacopteryx saba*, crushed and ate a *Papilio angolanus*, refused, then tasted and rejected the ♂ *Papilio echerioides*; refused to touch a *Neptis agatha*, readily ate another *Papilio angolanus*, once more obstinately refused to taste a *Neptis agatha*, tasted and rejected *Eurytela hiarbas*, refused persistently without tasting *Eurytela dryope*, readily ate another *Papilio angolanus*, once more refused to have anything to do with *Neptis agatha* or ♂ *Papilio echerioides*, accepted suspiciously but having tasted it readily ate a *Henotesia perspicua*, two more grasshoppers and yet another *Papilio angolanus*. I was here interrupted.

Fifteen minutes later she readily ate six grasshoppers and a *Papilio angolanus*, refusing without tasting *Neptis agatha*. After three more grasshoppers she refused persistently without tasting *Neptis agatha*, *Eurytela dryope*, and *Papilio angolanus*. It struck me to get them definitely tasted by offering a very minute grasshopper or a small portion of a grasshopper between each. I therefore now gave the bird a very diminutive grasshopper from the well-known tin and then from the same tin a *Papilio angolanus.* The bird was distinctly surprised at finding this in its bill instead of the expected grasshopper, but as it *was* there [or because of stimulation by the grasshopper] she proceeded to crush and swallow it. The next was a *Neptis agatha*, which was well crushed and rejected, and *Eurytela hiarbas*, which was similarly crushed but eaten, as was also a *Papilio angolanus.*

After three more small grasshoppers, *Papilio angolanus*, at first refused, was, after a minute grasshopper, crushed and definitely rejected, *Leuceronia argia* ♀ similarly crushed and thrown away, *Papilio demodocus* crushed and readily eaten, *Papilio dardanus* readily eaten, and *Papilio angolanus* and *Eurytela dryope* persistently refused without tasting. The bird then refused to touch a grasshopper nor would she look at any of a varied series of grasshoppers that I now offered her in turn. She also persistently refused without tasting *Papilio demodocus* ♂ and *Papilio antheus*; crushed and liking it readily ate a *Charaxes ethalion*, refused *Papilio demodocus*, ate after crushing it well *Papilio antheus*, and even more readily a second *Charaxes ethalion*; again refused *Papilio demodocus*, crushed well and ate *Papilio antheus*, and declined once more to have any dealings with *demodocus*, also however refusing without tasting *Precis archesia*, *Precis antilope*, a grasshopper, and *Precis cebrene*, being evidently nearly replete.

[Summary :—

1. *C. ethalion.*
2. *P. antheus.*
3. *P. demodocus.*

L. argia ♀. { 4. *P. angolanus, H. perspicua.*
5. *E. hiarbas.* } *E. dryope* and
6. *N. agatha* and *Terias brigitta.* } *P. echerioides* ♂.

P. saba was probably placed at any rate not appreciably below *N. agatha* and *P. echerioides* ♂. It was probably stimulation by *C. ethalion* that caused *antheus* to be eaten right up to *cebrene*-refusing point, but *antheus* was in any case definitely preferred to *demodocus.*

A. rabbaiæ is likely to be amongst the pleasanter Acræas.]

Exp. 84.—*September* 9. There was food in the cage, but I fed the bird by hand on various Orthoptera till she absolutely refused to touch another. She then crushed thoroughly and rejected *Papilio angolanus*, refused several different palatable grasshoppers, readily ate two *Charaxes candiope*, tasted and rejected *Papilio demodocus*, readily ate a *Charaxes pollux*, refused, then tasted slightly and rejected *Papilio demodocus*, refused without tasting *Salamis cacta* and *Pyrameis cardui*, then simply took in the point of her bill and dropped *Hypolimnas wahlbergi* and *Salamis cacta*, first looking at the former with some suspicion (its body and forewing no doubt reminded it of things unpleasant), and refused most obstinately to taste *Pyrameis cardui.* Three minutes later she refused persistently without tasting *Pyrameis cardui*, *Salamis cacta*, *Salamis anacardii*, *Hypolimnas wahlbergi*, and *Precis cebrene.*

Later in the day a second small experiment failed in its object. I fed the roller just too much, and all the above butterflies were once more persistently refused without tasting.

[SUMMARY :—

(*a*) 1. *C. pollux* (and *H. wahlbergi*, *S. cacta*, *P. cardui*, *P. cebrene*, *S. anacardii* apparently not preferred to it).
2. *P. demodocus*, *P. angolanus*, various favourite grasshoppers.

C. candiope was also preferred to *P. angolanus* and the grasshoppers.]

Exp. 85.—*September* 10. Fed the roller on various Orthoptera, &c., till she would eat no more. She then refused but went on to taste and reject *Papilio demodocus* and *Papilio angolanus*, just took *Hypolimnas wahlbergi* listlessly in the tip of her bill and dropped it, also *Precis cebrene*, and refused without tasting *Pyrameis cardui*, *Precis natalensis* ⊙ f., *Salamis anacardii*, and *Salamis cacta*. After an interval she refused without tasting *Papilio demodocus*, *Euralia wahlbergi*, and *Salamis cacta*, crushed and readily ate a mimetic *Baoris* and a Lycænid (probably *Zeritis* of outskirts), but then went on to eat also *Papilio demodocus* and *Eurytela dryope*, rejecting at once however after she had tasted it *Neptis agatha*. I decided not to reoffer the two main butterflies of the experiment as the bird was too hungry once more and I had given away such grasshoppers as remained. The *Salamis cacta* was in any case now dead.

[Probable that the *Baoris* was preferred to *P. demodocus* and, *if she really knew them*, to *H. wahlbergi* and *S. cacta*. The *Zeritis*, eaten after stimulation, was not necessarily better liked than the *E. dryope*.]

Exp. 86.—*September* 11. Had just been feeding and had returned to her usual perch presumably satisfied, leaving a number of very favourite insects uneaten. She then refused obstinately to touch *Mylothris rueppelli* or a *Terias*, but readily accepted and ate *Neptis agatha*, most readily accepted a number of grasshoppers by hand, including those she had abandoned, and finally absolutely refused to touch either another grasshopper, *Neptis agatha*, *Papilio lyæus*, or *Papilio demodocus*. Three minutes later she tasted and rejected *Papilio lyæus* and *Papilio demodocus*, looked very suspiciously at both *Euxanthe wakefieldi* and *Hypolimnas wahlbergi*, both wingless, the bodies in each case being very reminiscent of *Danainæ*, then took each in a gingerly manner in the tip of her bill and dropped it, I believe quite without tasting, readily accepted and ate *Precis natalensis* ⊙ f., *Papilio policenes*, *Papilio antheus*, and *Papilio hippocoon* (each with one wing), doubtfully refused without tasting *Euxanthe wakefieldi* and *Hypolimnas wahlbergi*, readily ate *Papilio hippocoon* and *Precis archesia*, refused without tasting *Papilio demodocus* and *Papilio lyæus*, but readily accepted and ate *Papilio hippocoon*, *Precis natalensis* ⊙, and *Precis archesia*. She then refused *Precis natalensis*, *Papilio hippocoon*, and *Euxanthe wakefieldi*, crushed slightly in the point of its bill and dropped *Precis cebrene*, accepted and ate *Salamis anacardii* and *Salamis nebulosa*, but refused the next as also several of the preceding butterflies reoffered.

Later she readily ate *Papilio angolanus* and three small grasshoppers, refused without tasting the next *Papilio angolanus*, also *Papilio lyæus* and *Papilio demodocus*, tasted and rejected *Euxanthe wakefieldi* and refused without tasting *Precis archesia*. It was obvious that the bird found the thorax of the *Euxanthe* unusually tough and though she gave it a sufficient squeeze to have crushed the average butterfly there was no evidence afterwards on the thorax itself of its having done so. Not five minutes later she again crushed and rejected *Euxanthe wakefieldi* and refused *Papilio lyœus* without tasting.

Five minutes later she readily ate *Papilio lyœus*, crushed very thoroughly and appeared greatly inclined to swallow *Euxanthe wakefieldi* but in the end rejected it, refused without tasting *Papilio demodocus*, tasted and rejected *Papilio lyœus*, readily accepted and after thorough crushing ate a *Papilio demodocus*, tasted and rejected *Neptis agatha* and refused without tasting *Euxanthe wakefieldi* and *Precis archesia* (wingless). Three minutes later she subjected to very thorough and very prolonged crushing *Euxanthe wakefieldi*, during which she twice nearly swallowed it, but each time brought it forward into the bill again and subjected it to renewed crushing. Finally she rejected it with a certain amount of hesitation.

I now offered a particularly large *Neptis agatha* which was accepted, but, on being tasted, at once and emphatically flung it away. The bird then readily ate a *Papilio lyœus* and refused without tasting the *Neptis agatha* and a *Papilio angolanus*. Two minutes later she barely tasted, then dropped *Euxanthe wakefieldi*; five minutes later she tasted and rejected *Papilio angolanus*, just took in its bill and dropped *Euxanthe wakefieldi*, readily enough ate a *Papilio lyœus*, crushed very thoroughly and swallowed with no sign of dislike *Euxanthe wakefieldi*, tasted and at once rejected *Papilio angolanus*, readily ate a *Papilio lyœus*, after it the *angolanus* reoffered; crushed and rejected the next *Papilio angolanus*, readily ate a *Papilio lyœus*, and refused persistently without tasting a *Papilio hippocoon*, a *Precis cebrene*, a *Papilio lyœus*, and a *Neptis agatha*.

[SUMMARY:—

1. *Salamis nebulosa* (and, if not the result of stimulation, *Salamis anarcardii*).
2. *Precis natalensis* ⊙ f., *P. dardanus* ♀ f. *hippocoon* (and, if not the result of special stimulation, *P. antheus*, *P. policenes*, and *Precis archesia*).
P. cebrene. 3. *Papilio lyœus* and *P. demodocus.*
4. *Euxanthe wakefieldi* and probably *P. angolanus.* *H. wahlbergi.*
5. *Neptis agatha.*
6. *Terias* and *M. rueppelli.*

Note at the time: "I had unfortunately no *Eurytela dryope* to offer with the *Euxanthe wakefieldi*, but am certain that the latter was not more distasteful to the roller than is *Papilio angolanus*, which nowadays roughly equals *Eurytela dryope*; possibly less, for there could be no doubt at all that the bird suspected both its appearance * and the toughness of its thorax and so probably tended to place it lower than its actual taste warranted. It appeared to be disliked (or suspected ?) distinctly more than *Papilio lyœus* and very distinctly less than *Neptis agatha*."]

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* White-spotted thorax and body, which both in its bulging shape and in the yellow colour of its fluff is highly reminiscent of *Amauris dominicanus*. The latter often has yellowish areas due to *bareness*.

Exp. 87.—*September* 12. Very hungry; tasted cautiously and promptly rejected, wiping her bill and showing every sign of the greatest disgust, a brilliant red adult "velvet mite" (*Trombidium* sp.) from Chirinda (it tasted intensely of *Amauris*-cum-quinine), crushed and rejected *Acræa asema*, readily ate a *Terias* and a wingless *Danaida chrysippus*, crushed well and very nearly swallowed but brought up and threw away *Acræa rahira*, crushed well and readily ate a wingless *Danaida*, crushed and rejected *Acræa rahira* with some hesitation and *Acræa anemosa* with promptitude.

A few minutes later I again offered her a *Danaida* which she for some time refused with emphatic shakes of the head but finally tasted. She at once rejected it, shaking her head and wiping her bill. This *Danaida* was in no way abnormal in the matter of smell and it seemed probable that the two preceding ones, perhaps not recognised without wings, had disagreed with the bird. The *Acræa rahira* was distinctly less disliked than either *Acræa asema* or *Acræa anemosa*, though more so than *Terias* or *Danaida*.

I now fed the bird on grasshoppers till she would eat no more. She then crushed and rejected *Papilio angolanus*, *Papilio trophonius* (v. above), and *Papilio dardanus* ♂. Five minutes later she readily ate a *Catopsilia florella* and a *Papilio dardanus* ♂, tasted and rejected the *trophonius*, readily ate a *Precis artaxia*, and again rejected the *trophonius*. Five minutes later she refused to touch the *trophonius*, but readily ate a *Precis natalensis* ⊙ f. and again refused *trophonius*. Five minutes later she refused *trophonius*, readily ate after crushing it *P. angolanus*, refused *trophonius*, tasted and rejected *angolanus*, refused *trophonius*, and readily accepted and ate *Precis archesia*. She then twice hesitatingly tasted (once by a leg, once by an antenna) the *Papilio trophonius* and refused it; again readily accepted and ate a *Precis archesia*, refused *trophonius*, crushed and ate *P. angolanus* and again refused *trophonius* and *Neptis agatha*.

[SUMMARY :—

Terias. {
1. *Precis archesia*. } *Precis natalensis* ⊙ f.
2. *P. angolanus*. }
3. *D. chrysippus*. } *P. dardanus* ♀ f. *trophonius* (refusal probably due mainly to suspicion of coloration).
4. *A. rahira*. }
5. *A. asema*, *A. anemosa*. }
6. *Trombidium* sp. (on manner). }

The *tendency* to try the *trophonius* was interesting, and suggested that it might require less to overcome suspicion of an imperfect mimic than of the model.]

Exp. 88.—*September* 23. Ate several grasshoppers; refused persistently to taste a *Terias*, and crushed and very promptly rejected a *Mycalesis campina*, readily ate *Neptis agatha* and *Eurytela dryope*, but after a few more grasshoppers rejected *Neptis agatha*.

I was interrupted here, but later the bird refused absolutely to touch *Terias*, shaking her head each time I offered it, refused for a moment, then, changing her mind, accepted and readily ate a *Neptis agatha*, refused persistently and with violent shakes of the head to have anything to do with a *Mycalesis campina*, ate readily four small grasshoppers, and after distinct hesitation and much crushing a *Papilio angolanus*, barely tasted the antenna of a *Papilio echerioides* ♂, and refused to have anything further to do with it; refused without tasting most persistently a *Papilio angolanus* and a *Papilio demodocus*, readily accepted and ate a *Precis natalensis* ⊙ f., again refused to touch a *Papilio angolanus*, and tasted very slightly and rejected a *Papilio echerioides* ♂.

[SUMMARY:—

(*a*) 1. *N. agatha*, bitter grasshoppers (and *E. dryope* and *P. angolanus* ?), ? *Terias*, and *Myc. campina.*

(*b*) 1. *P. natalensis* ⊙ f.

2. *P. angolanus*, *P. demodocus*, *P. echerioides* ♂.]

Exp. 89.—*September* 24. Ate a number of grasshoppers, then readily a *Papilio demodocus*, a *Neptis agatha*, and several more grasshoppers. She then refused absolutely to eat any more of the latter, crushed and threw away a *Papilio demodocus*, crushed at great length a flower-haunting mantis (*Pseudocreobotra wahlbergi*), then remained holding it as though replete but not liking to part with it, finally again crushed it well and tossed it aside, rejecting in the same way *Papilio policenes* and *Precis natalensis* ⊙ f. Five minutes later she once more accepted each with disinclination and threw it away. Five minutes later she refused the *Mantis* and *Papilio policenes*, tasted and rejected *Papilio demodocus*, crushed well and ate with apparent relish the mantis and refused persistently without tasting *Papilio demodocus*, *Papilio policenes*, *Papilio lyæus*, and *Charaxes candiope.*

There could be no doubt that the bird placed the mantis very high, enjoying it thoroughly in spite of the fact that it haunts flowers most conspicuously. [It is probably not lower than *Papilio policenes*, possibly higher, even perhaps as high as *Charaxes.*]

Exp. 90.—*September* 28. Hungry; readily ate a *Terias.* I now placed a handful of Orthoptera in the cage, and the bird at once descended, ate a number of them (which it appeared to pick up at random apart from the usual preference for the larger spp. on commencing to feed), and retired to a high perch presumably satisfied. She then nevertheless ate not only a *Neptis agatha* and a *Mycalesis campina*, but a *Terias brigitta.* After six more grasshoppers given by hand she again readily accepted and ate a *Neptis agatha* and a *Mycalesis campina*, but persistently refused, with shakes of the head, to touch a *Terias.*

After six more grasshoppers she for some time refused to touch another, although I offered her several favourite species in turn. At last, however, she accepted one and once more refused all I offered, then ate another, and finally and most persistently refused to have anything to do with any others. On my now giving her a *Precis natalensis* ⊙ f., she just took it in the point of her bill and tossed it aside, but, attracted by the struggles of a *Papilio lyæus*, definitely crushed this and flung it away. She then refused but, changing her mind, accepted and ate with apparent relish *Salamis cacta* and the *Precis natalensis* ⊙ f. which I reoffered, refused to touch a *Precis madagascariensis*, but recognised with evident pleasure and accepted and ate a second *Precis natalensis* ⊙ f. She then accepted a *Charaxes pollux*, crushed it well and held it in her bill for two or three minutes, being evidently loath to relinquish it, yet feeling that she could not find space for it. Finally she dropped it. She then refused a *Charaxes candiope*, but in the end, attracted by its violent fluttering, accepted and ate it; took in her bill and dropped through sheer repletion a *Charaxes pollux*, a *Charaxes cithæron*, and a small queer termite, and refused persistently even to taste a very favourite grasshopper.

I reoffered all four insects three times at intervals of ten minutes, but they were each time ignored.

[Summary:—

1. *Salamis cacta* var. *languida*.

Higher grade grasshoppers. *P. lyæus.*
2. *Precis natalensis* ⊙ f. (to *Charaxes*-refusal point).
3. *Precis orithyia* var. *madagascariensis*. *Terias* (not *higher* apparently than *N. agatha* and *M. campina*).]

Exp. 91.—*September* 30. Fed with grasshoppers till she would absolutely not touch another. She then most obstinately refused to taste *Papilio angolanus*, accepted *Papilio demodocus*, subjected it to very prolonged crushing, being quite evidently doubtful whether to swallow it, but finally did so; *readily* ate a *Charaxes brutus*, obstinately refused to have anything to do with a *Papilio demodocus* and a *Papilio lyæus*; crushed and readily ate a *Charaxes pollux*; again refused to touch *Papilio demodocus*, *Papilio angolanus*, and *Papilio lyæus*; readily ate a second *Charaxes pollux*; held for some time and finally dropped a *Precis artaxia*; refused, then accepted and ate with relish a large moth, *Nyctipao macrops*, refused without tasting *Precis artaxia*; crushed, held, and finally swallowed *Charaxes candiope*. She was evidently nearly replete. Three minutes later I reoffered the *Precis artaxia*, which was this time eaten readily, while *Papilio lyæus*, *Papilio demodocus*, *Papilio policenes*, and *Papilio angolanus* were obstinately refused without tasting, and *Leuceronia thalassina* tasted and rejected.

[Summary:—Assuming the three large species of *Charaxes* to be of the same grade we have

1. *C. brutus*, *C. pollux*, *C. candiope*, *Nyctipao macrops*.
2. *Precis artaxia*.

Pap. lyæus.
3. *Pap. demodocus*.
4. *P. angolanus*; grasshoppers.

It is probable that *P. artaxia* was also preferred to *P. policenes* and *L. thalassina*, though the offerings were in the wrong order to render this certain.]

Exp. 92.—*October* 10. I offered the roller (hungry) a section of a smallish "night-adder," about 1½ in. long. Usually a quite imperturbable bird, she now at once dashed to the back of the cage with great fright and scurry of wings, but, gradually recovering herself, returned to her usual perch and after very slight hesitation accepted the piece, crushed it once or twice, and threw it away. I reoffered it three times and she each time did the same, evidently not sure whether she cared for it or not. The next time, however, she swallowed it (a fairly thick piece). I then cut out and offered a small scrap of the snake's flesh without skin. This she tasted very deliberately and rejected, but she ate it on its being reoffered. The next piece she again tasted and rejected, and thenceforth would have nothing to do with it, refusing it most obstinately. She very readily, however, ate a *Neptis agatha* and a *Terias senegalensis* (I had unfortunately nothing more unpleasant than the latter to offer, but the bird was still distinctly hungry), followed by four smallish grasshoppers. She then refused utterly with shakes of the head to touch the small piece of snake-flesh, but readily accepted and ate another *Terias*, once more persistently refusing the piece of snake.

A little later, after several more grasshoppers, she refused a *Terias* but eagerly accepted and ate a *Neptis agatha*, *Mycalesis campina* ♂ and ♀, and the *Terias* reoffered. After ten more grasshoppers she refused repeatedly and obstinately to touch a *Terias*, but most readily accepted and ate a *Neptis agatha*.

[SUMMARY :—

1. *N. agatha* (*M. campina* perhaps the result of stimulation).
2. *Terias senegalensis*.
3. Night-adder.

The fear shown by an occasional snake-eater at the unexpected appearance of a bit of snake was interesting.]

Exp. 93.—*October* 12. The bird was obviously hungry. She crushed well, hesitated for a few seconds over, then threw right away a ♂ *Lampyris marginepennis*, readily accepted and ate *Terias senegalensis*, twice refused but, changing her mind, the result doubtless of her hunger, accepted, crushed lightly, and at once threw away a second *Lampyris*, crushed and readily ate a *Mylothris yulei*, but again tasted and rejected the *Lampyris*, as also *Amauris dominicanus*.

She then ate four small pieces of fresh meat (lamb) and refused the next, but though coaxed into eating it flatly and finally refused to have anything to do with the next. She refused equally obstinately to touch a *Terias*, but readily accepted and ate a *Mycalesis campina*, afterwards once more refusing the *Terias*. I then gave her six grasshoppers, after which she fairly readily ate another *Mycalesis campina*, then crushed well and finally flung away a wood-boring longicorn, *Ceroplesis caffer*, of which I had removed one elytron, afterwards utterly and obstinately refused to have anything further to do with it. The beetle in question smelt slightly of sandal-wood and a clear white liquid exuded when the elytron was removed.

Ten minutes later she tasted and at once flung away a small piece of lamb's meat, ate eleven small grasshoppers and refused utterly to touch another; crushed and rejected *Papilio angolanus*, refused for a second then crushed and very readily ate an *Arrugia basuta* ♀, tasted and rejected *Papilio lyæus*; refused for a second, undoubtedly through disinclination, then accepted and readily ate a ♂ *Arrugia basuta*, refused without tasting *Hypolimnas wahlbergi* and for a second *Precis artaxia*, but then, changing her mind, accepted and ate the latter; accepted *H. wahlbergi* with a little hesitation, but having tasted it appeared quite reassured and crushed and swallowed it; held *Precis natalensis* ⊙ f. a good many seconds before crushing and swallowing it; played with *Catacroptera cloantha* and *Hamanumida dædalus*, tossing them up into the air and catching them and finally letting each drop, refused *Precis cebrene*, but, changing her mind, accepted it, held it in her bill for a time and finally crushed and swallowed it, and refused without tasting *Hamanumida dædalus*, *Catacroptera cloantha*, and *Precis cebrene*. Five minutes later she refused to touch a ♀ termite or any grasshoppers, but accepted and ate *Catacroptera cloantha*, *Hamanumida dædalus*, *Precis cebrene*, and *Catopsilia florella*, holding each for some time before swallowing it; refused, then tossed up into the air a ♂ *Arrugia basuta*, a *Precis artaxia*, *Precis natalensis* ⊙ f., and *Precis cebrene*. Five minutes later again and once more ten minutes after that she refused to taste any of them nor would she touch a ♀ termite nor any of the various grasshoppers offered her.

[SUMMARY:—

M campina.	1. *P. cebrene*, perhaps slightly over 2. *C. cloantha* and *H. dædalus.*	*A. basuta* ♂ and ♀, *P. artaxia*, perhaps *C. florella*, probably *H. wahlbergi* and *P. natalensis* ⊙ f.
P. lyæus.	3. Favourite grasshoppers.	
C. caffer.	4. *T. senegalensis*, *M. yulei*, lamb.	
Termite.	5. *Lampyris marginepennis* ♂ and probably *Amauris dominicanus.*	

"The roller was in excellent, emphatic form."]

Exp. 94.—*October* 13. After a number of grasshoppers the bird readily ate *Papilio angolanus*, four more grasshoppers, *Papilio lyæus*, and *Charaxes brutus*, then refused obstinately to touch a second *Papilio lyæus* or *Papilio leonidas* (with one forewing attached to distinguish it more clearly from *Papilio angolanus* which had had a hindwing). Five minutes later she crushed and rejected *Papilio leonidas*, readily ate a *Precis artaxia*, and crushed and rejected *Papilio lyæus*, thus placing *Papilio leonidas* below *Precis artaxia*, *P. lyæus* not above it, and *P. leonidas* and *P. lyæus* each probably not above *C. brutus*.

Exp. 95.—*October* 14. Readily ate in the morning several grasshoppers and a *Mycalesis campina*, crushed thoroughly (with distinct difficulty at first in retaining her grip on it owing to the hard polished surface of its elytra) and ate without sign of dislike a black and white Cetoniid, then several more grasshoppers and a *Mycalesis campina*. I then fed her on grasshoppers, crickets, etc., till she absolutely and persistently refused to touch another, though I passed several very favourite species in review before her.

She then refused without tasting *Papilio angolanus*, tasted and rejected *Papilio leonidas*, and, but with apparent disinclination, a *Papilio lyæus*, refused, then tasted and flung right away the *Papilio angolanus* and once more tasted, this time slightly, and threw aside the *Papilio leonidas*. Five minutes later she crushed and once more rejected the *Papilio leonidas* and persistently refused even to taste *Papilio angolanus*. Fifteen minutes later she crushed and rejected each. Ten minutes later again she once more crushed and rejected each. Twenty minutes later she readily ate a *Papilio angolanus*, a *Mycalesis campina*, and four small grasshoppers, after which she once again refused to touch another; refused, then tasted and rejected *Papilio leonidas*, and refused without tasting *Papilio angolanus*.

Ten minutes later she obstinately ignored both, also grasshoppers.

[SUMMARY:—

1. *P. lycæus.*
2. *P. leonidas* and *P. angolanus*, and grasshoppers. *P. leonidas* not above *P. angolanus*.

Note ability to reduce black and white Cetoniid.]

I was short of butterflies for the experiment, but in the late afternoon, two *Neptis agatha* having come in in the meantime, I again gave her by hand a number of grasshoppers, after which she readily ate a *Mycalesis campina*, four more grasshoppers, and a *Neptis agatha*, six more grasshoppers, and a second *Neptis agatha*. I now, rather expecting a rejection, offered her the same species of Cetoniid that she had already eaten in the morning. A moment afterwards I regretted doing so, for it was eaten after the usual crushing and being a comparatively bulky article of diet carried the bird a stage too far and caused her to now refuse *Papilio leonidas* and *Papilio angolanus* without tasting. Four or five times subsequently by lantern-light at about ten-minute intervals I offered the two species of *Papilio*, but the bird had settled down for the night and absolutely refused to touch them.

The *Papilio leonidas* was already dead in the above experiment, but having been kept on damp earth was still perfectly fresh and supple. It was, at any rate, not appreciably preferred to the Cetoniid, which was once more reduced.

Exp. 97.—*October* 20. Hungry; crushed and rejected a ♀ *Aletis monteironis*, *Acræa satis* ♂ and a spotted Hypsid moth, *Argina amanda*, accepted most readily and ate a *Terias brigitta*, and tasted and rejected an *Acræa asema*.

Later in the day, to test the probable value of the resemblance between *Charaxes brutus* and *Papilio echerioides* ♂, I carried out the following experiment, at the same time experimenting on *Pycnonotus layardi* (B) with model and mimic reversed. I first fed the roller up on various Orthoptera (including migratory locusts, crickets, locustids, and small grasshoppers of various kinds) until she absolutely refused to touch another.

I then offered her a ♂ *Papilio echerioides* with upper surface of wings fully displayed. She took it by the base of one of the forewings, crushed it there and threw it away, refusing to have anything to do with it on my reoffering it. I then offered instead *Charaxes brutus*, its upper surface similarly displayed. The roller refused to have anything to do with it. On my closing its wings, however, and reoffering it, this time of course with only the narrowly-barred under surface showing, the bird seized it with actual eagerness, crushed it well, and swallowed it with evident relish. The wings were not removed and as the insect was brought into final position for swallowing, head first, they projected prominently on each side of the bill with their upper surface vividly displayed so that the bird could not have failed to take note of it. That she had done so was proved by the fact that on my now offering a second *Papilio echerioides* ♂ with the upper surface once more exhibited, the bird edged towards it with a somewhat doubtful air, took it from the forceps but then at once threw it right away in disgust, afterwards ignoring a second *Charaxes brutus*, offered with the upper surface towards her.

[It was evident from this experiment that for a bird in the appropriate stages of repletion *Papilio echerioides* is capable of acting most effectively as a model for *Charaxes brutus*.

Preferences: *T. brigitta* was preferred to *A. monteironis*, *A. satis* ♂, and *Argina amanda*, and at any rate probably not *less* than *A. asema*.]

Exp. 98.—*October* 21. After several grasshoppers the bird ate, though with disinclination, a *Mycalesis campina*. After three more small grasshoppers she persistently refused to have anything to do with a second *Mycalesis campina*, but accepted and ate, again with an air of disinclination, a *Neptis agatha*, afterwards refusing persistently once more to touch the *Mycalesis campina*. I then offered a Coprid which I had found rolling a millipede. She eagerly seized it, but directly pressure was applied to its glossy surface the beetle shot away to the other side of the cage. Three or four times the roller obtained an excellent grip, but quite failed to crush the beetle, though she appeared to exert her greatest force, and the end was always the same—the beetle shot out violently and rebounded from the side of the cage. At last the bird lost her temper and taking it from the forceps dashed it to the ground, after that edging away every time I offered it. I then offered the millipede (*Spirostreptus* sp.). She crushed it three or four times with her bill and rejected it; then refused to accept *Neptis agatha* or a *Mycalesis campina*.

[*Neptis agatha* was preferred to *Mycalesis campina*, and at this stage the roller was deterred by *Sceliages adamastor* from continuing her attempts to crush it after about four attempts, hardness and gloss being the qualities that led to this result. A broken-up millipede, probably dead for some time, was rejected at the same stage.]

Exp. 99.—*October* 23. Had been feeding on grasshoppers. I offered her a wingless *Pyrameis*, the top of whose thorax I had smeared thinly with honey. The roller accepted it readily, but at once flung it away in disgust and wiped her bill vigorously on the perch. She then refused without tasting *Neptis agatha*, but readily ate some working termites, of which insects she is usually not very fond.

The experiment suggested that a new, strong or unexpected taste not in itself unpleasant may cause suspicion in an experienced bird and bring about rejection. It was carried out to test this view.

Exp. 100.—*October* 24. Readily ate a *Mycalesis campina*, then accepted a Coprid found rolling dung yesterday in the forest, crushed it for some time without however breaking it up greatly, and swallowed it. She did not experience with this beetle the difficulty of the other day. She then tasted and rejected an *Aletis monteironis*, readily ate a *Terias*, and tasted and at once rejected a Lycoid beetle.

I now fed her up on grasshoppers, &c., till she would eat no more, absolutely refusing several favourite species in succession. She then refused a *Mycalesis campina* and tasted and rejected *Neptis agatha.* Thereupon I offered her *Plœsiorrhina plana,* a large black Cetoniid beetle crossed by a white bar which occurs now at the bananas. She had the greatest difficulty in dealing with this; it occasionally slipped out of her bill, though less so than the Coprid of the other day; once it succeeded in opening its wings and gave vent to a loud buzz like that of a *Xylocopa* bee. The roller at once dropped it in alarm and on my reoffering it only accepted it after marked hesitation. Three times the insect, held back downwards, clasped the bird's upper mandible with its particularly tenacious feet. This irritated the bird beyond measure; it was only with the greatest difficulty that she managed each time to extricate herself from the Cetoniid's embrace and she at once flung it away with a great show of rage, finally refusing to have anything more to do with it. She then refused without tasting *Neptis agatha,* accepted a speckled Cetoniid, *Diphrontis vethi,* captured to-day in the forest, and obtaining without difficulty a good grip on it, for it was flat in shape and not markedly slippery, she crushed it with her bill, but, making very little impression, battered it well against the perch (the beetle once slipped from her bill and had to be re-offered), crushed it again for some time with her bill, this time with greater success, and swallowed it still very much alive. She then reaccepted though without eagerness the first Cetoniid. It at once shot out of her bill when pressure was applied, and the bird refused persistently and repeatedly with emphatic shakes of the head to have anything more to do with it.

Twenty minutes later I offered it again, when it was distinctly tasted, the bird obtaining a good grip, and rejected. *Neptis agatha* was refused without tasting. Ten minutes later the bird again tasted the Cetoniid, once more obtaining a firm grip and crushing well in, and ended by flinging it away. It was quite evident that it was not liked. She then readily ate *Neptis agatha,* and obstinately refused with many shakes of the head to taste the beetle again.

Half an hour later, no food meantime, I offered a *Belenois mesentina.* The bird, at the far end of a perch, edged up with a certain amount of hesitation, tasted it cautiously, and retired with a shake of the head.

[SUMMARY:—*Terias* preferred to *Aletis, N. agatha* to *Plœsiorrhina plana,* and *Diphrontis vethi* found easier to manage than the *Plœsiorrhina,* which was itself also possessed of some unpleasantness in addition to its very excellent deterrent degrees of hardness, gloss, and clawing. The Coprid was eaten without much breaking at the stage of refusing *Aletis* but eating *Terias.* Somewhat high unpleasantness of *B. mesentina* reaffirmed.]

Exp. 101.—*October* 28. I fed the bird on grasshoppers till she persistently refused to touch another. She then refused, but on my pressing her tasted and rejected a *Papilio angolanus,* crushed and readily ate a pupa of a Longicorn beetle, *Anthores leuconotus,* refused, then tasted and rejected a dead but supple *Papilio ophidocephalus* without wings, readily ate a *Catacroptera cloantha,* and once more tasted, this time crushing it better, and rejected a *Papilio ophidocephalus.*

[That is to say, *Catacroptera cloantha* and the pupa of *Anthores leuconotus* were preferred to any grasshoppers, to *Papilio ophidocephalus*, or to *P. angolanus*.]

Exp. 102.—*November* 3. Fed on grasshoppers till she repeatedly and persistently refused to eat any more, though several palatable species were offered. She then readily ate two large moths, *Sphingomorpha chlorea*, crushed and rejected a *Papilio lyæus*, and refused without tasting an *Aterica galene* (♂), headless and with half a hindwing attached, the latter perhaps reminding her of *Neptis*. There was in any case no mistaking the fact that she was thoroughly replete. On my continuing to present the insect she took it, and without crushing it threw it away, doing this a second time on my continuing to offer it. I then offered her a *Precis cebrene* with two wings attached. She similarly refused this, then took and threw it away, and, as in the case of the *Aterica*, once more threw it away (this time, however, first actually crushing it) on my continuing to reoffer it. On my reoffering it yet again she accepted it, crushed it with more deliberation, and swallowed it without a sign of dislike, but refused *Papilio lyæus*. She then, though with disinclination, accepted the *Aterica*, crushed it with the same deliberation, as in the case of the *Junonia*, and swallowed it, again with apparent relish. She then persistently and repeatedly refused to touch *Papilio lyæus*. Five minutes later I offered her a ♀ *Arrugia basuta*, a *Precis cebrene* (upperside exposed) and a *Hamanumida dædalus*, but she persistently refused all without tasting, being thoroughly gorged.

[SUMMARY :—

1. *P. cebrene* and *Aterica galene* ♂.
2. *P. lyæus* and grasshoppers.

Sphingomorpha chlorea was preferred to the grasshoppers, and the *Aterica* was eaten up to refusal-point for *Arrugia basuta* ♀, *P. cebrene*, and *H. dædalus*.]

Exp. 103.—*November* 11. I fed the bird on grasshoppers till she finally and repeatedly refused to accept any more. She then accepted *Papilio angolanus* with an air of hesitation, crushed it slightly and at once flung it right away, readily but slowly, being evidently nearly replete, crushed and ate a *Charaxes brutus* and a *Charaxes candiope*, refused without tasting a *Hypolimnas wahlbergi*, which she seemed to view with suspicion, barely crushed it, if at all, and threw it away; then with equal disinclination accepted a *Precis cebrene* and crushed it too and threw it away. Three minutes later she again accepted and this time ate the *Precis cebrene*, but persistently refused to taste the *Hypolimnas wahlbergi*, even on my removing its one wing. She finally took it and repeatedly tossed it into the air, catching it each time as it fell. She then dropped it and refused persistently to accept a *Precis cebrene* or a ♂ *Arrugia basuta*. Five minutes later she refused for a time but afterwards crushed and rejected the *Hypolimnas wahlbergi*, but readily ate a ♀ *Arrugia basuta*.

Ten minutes later she refused *Hypolimnas wahlbergi* without tasting, readily accepted and ate *Catopsilia florella*, once more persistently refused to taste

Hypolimnas wahlbergi, readily ate a ♂ *Arrugia basuta*, then, after refusing it again, accepted, crushed well and rejected the *Hypolimnas wahlbergi.*

Twenty minutes later by dim lantern light she crushed and readily swallowed the *Hypolimnas wahlbergi*, but rejected with every sign of disgust a *Papilio angolanus*, also without wings.

[SUMMARY :—

(*a*) 1. *Charaxes brutus* (and *C. candiope*?).
2. *P. angolanus* and grasshoppers.
(*b*) 1. *Arrugia basuta* ♂ and ♀, and *C. florella.*
2. *Hypolimnas wahlbergi* (not worse, probably better, than *P. angolanus*).]

Exp. 104.—*November* 13. Fed on grasshoppers till she persistently refused to accept another (several favourite spp. were refused), she ate but with disinclination a *Papilio angolanus* and refused to have anything to do with a second. She then accepted eagerly enough, crushed slightly and nearly swallowed a large Saturniid moth without wings, but brought it forward into her bill once more and subjected it to a very prolonged tasting, evidently feeling quite doubtful about it, before finally throwing it away. She then once more refused to taste *Papilio angolanus*, but accepted, crushed well, and swallowed with apparent relish a large Noctuid, *Argadesa materna*, with two wings attached to distinguish it from the Saturniid. She then, evidently quite replete, refused persistently without tasting a *Precis cebrene*, a ♂ *Arrugia basuta*, a *Catopsilia florella*, and a *Charaxes cithæron.*

Fifteen minutes later she refused *Papilio angolanus*, then barely closed her bill on one of its antennæ and withdrew with shakes of the head; refused the Saturniid moth and then, as in the case of the preceding offering, barely closed her bill on it and withdrew with signs of dislike. She readily, however, ate the *Precis cebrene* and the ♂ *Arrugia basuta*, but refused, then crushed well, and rejected the *Catopsilia florella.* It appeared just possible that she had in mind other and distasteful white species and did not allow the evidence of her taste to overcome her suspicions, for she now readily enough accepted and ate another *Arrugia basuta* (♀).

[SUMMARY :—

1. *P. cebrene*, *Arrugia basuta* ♀ (and probably ♂), *Argadesa materna* (the latter to refusal-point for *P. cebrene*, *Arrugia basuta*, *C. florella*, and *Ch. cithæron*).
Saturniid. { 2. *P. angolanus.*
3. Grasshoppers.]

Exp. 105.—*November* 14. Refused, then tasted and rejected an *Aletis monteironis*, persistently refused even to taste *Mylothris yulei*, but readily ate a *Mycalesis campina.* She then ate three smallish grasshoppers and refused without tasting, but, changing her mind, accepted and swallowed another *Myc. campina.* She exactly repeated the performance in connection with each of five more *Myc. campina*, offered as before at intervals of three grasshoppers. She then crushed well and swallowed without sign of dislike yesterday's Saturniid moth and after it another *Mycalesis campina*, and, to my surprise, a *Terias*, having persistently refused to taste a *Mylothris yulei* before the last acceptance.

[*Note*: "Each *Mycalesis* in this experiment, as also the *Terias*, was at once swallowed down, wings and all, without any attempt at preliminary crushing. The experiment ran very quickly in spite of the refusals, and it seemed to me that the bird was in rather a reckless mood, and, starting very hungry, decided each time to swallow the insect and chance the results, though probably already past the stage at which it would ordinarily have rejected it. Thus, all that can be said with regard to the Saturniid is that it is less unacceptable than *Mylothris yulei* and *Aletis monteironis*, probably hardly *distasteful* at all in view of its treatment yesterday by the roller and on the 2nd by the kingfisher."

It is interesting to let the above note stand, but actually, no doubt, the acceptances of this experiment were excellent and extreme instances of the result of special stimulation by "the preceding offering." However, *Terias* and *M. campina* were preferred to *M. yulei*, and the *Mycalesis* at any rate to *Aletis monteironis*.]

Exp. 106.—*November* 16. Hungry; tasted and at once rejected an ant (*Myrmicaria eumenoides*, Gerst.), readily ate a *Papilio angolanus*, tasted and rejected another ant (*Dorylus gerstaeckeri*, Emery), ate with apparent relish a *Terias*, tasted and flung away with marked disgust an *Osprynchotus flavipes* ♀. I then fed her upon grasshoppers till she persistently refused several favourite species in succession, after which she tasted and rejected (after at first refusing each) *Papilio angolanus* and *Leuceronia thalassina* ♀, but readily ate *Catacroptera cloantha*, ♂ *Arrugia basuta*, and two spp. of moths, *Sphingomorpha chlorea* and another, two of each, refusing the rest as also *Precis cebrene*, undoubtedly through sheer repletion.

[Summary :—

1. *Cat. cloantha* (and perhaps, but not certainly, *A. basuta* ♂ and the two moths).
2. *P. angolanus*, *Terias*, grasshoppers.

L. thalassina ♀. 3. *Myrmicaria eumenoides* and *Dorylus gerstaeckeri*, also, on manner, *Osprynchotus flavipes* ♀.]

Exp. 107.—*November* 25. Readily ate a *Mycalesis campina*, three small grasshoppers, another *Myc. campina*, three more grasshoppers and a third *Myc. campina*, three more grasshoppers and a fourth *Myc. campina*. She then, after yet another three grasshoppers, refused persistently to touch a *Myc. campina*, a *Neptis agatha*, a *Papilio angolanus*, or a *Herpœnia eriphia*.

Ten minutes later she refused for a time but finally accepted and ate a *Myc. campina*, and, more readily, a *Papilio angolanus*; refused, then tasted and rejected a second *Myc. campina*, but readily ate, after tasting it well, the *Herpœnia eriphia*; refused, then tasted very slightly and once more refused a *Myc. campina*, tasted and rejected a *Phymateus viridipes*, refused persistently to touch a portion of its abdomen which I broke off and offered in case the whole insect had been too large or too much trouble to eat in the then state of her appetite, edging away from it when I continued to hold it to her; refused for a time a *Myc. campina*, then tasted it slightly and withdrew from it, and finally knocked it out of my forceps irritably with a sidelong blow of her bill. She readily, however, ate a *Neptis agatha*, then once more refused the *Myc. campina*.

[SUMMARY :—*H. eriphia*, *N. agatha*, and, on manner, *P. angolanus* were preferred to *M. campina*, and *N. agatha* to *Phymateus viridipes*.]

Exp. 108.—*November* 26. Noticing that the two fragments of yesterday's *Phymateus* (the thorax was still alive) had almost completely lost their characteristic smell (it was still just noticeable on opening the wings at the point where they joined the thorax), I decided to once more offer it to the roller. I therefore fed her till she refused to eat any more grasshoppers, and refused, then doubtfully tasted and rejected *Papilio angolanus*. She then accepted the *Phymateus* abdomen and subjected it to a very prolonged tasting, making once or twice as though to swallow it before at last rejecting it. I then reoffered it twice and it was each time once more accepted, crushed, and dropped. On the third occasion it was refused without tasting.

Ten minutes later she again refused, but after some persuasion tasted slightly and rejected *Papilio angolanus*, twice tasted and doubtfully rejected a small portion of the *Phymateus* abdomen, afterwards refusing it without further tasting, and twice tasted and dropped its thorax, afterwards refusing it too without tasting. She then accepted an unidentified beetle, pressed it once or twice, but made no real attempt to crush it, and finally dropped it, obviously because too replete to go to the trouble of crushing it. On my reoffering it, she treated it again in the same way. She then tasted slightly and rejected *Papilio angolanus*, crushed and readily ate *Precis artaxia*, refused through sheer repletion, then accepted and ate a *Precis madagascariensis*; refused, then ate a ♀ *Arrugia basuta*; refused, then ate two *Precis artaxia* and rejected with disgust the Meloid beetle, *Lytta designata*, exuding from its thorax a small quantity of yellow juice.

Ten minutes later she readily ate after crushing it the small Cetoniid, *Leucocelis parallelocollis*, experiencing no difficulty from its hardness or polish.

[SUMMARY :—*Note*: "The long and repeated trials given by the roller to-day to the *Phymateus* when practically replete contrasted strongly with its prompt dismissal of the insect yesterday when considerably hungrier, and seemed to show that the unpleasant taste and odour are chiefly confined to its frothy exudation and disappear with its disappearance."

P. ataxia (and probably *P. madagascariensis*, *Arrugia basuta* ♀, and *Leucocelis parallelocollis*) was preferred apparently to *P. angolanus*, the unidentified beetle (which the roller at that stage of appetite would not trouble to crush), *Phymateus viridipes*, and even favourite species of grasshoppers.]

Exp. 109.—*November* 27. Tasted well and rejected a *Zonocerus elegans* and refused persistently without tasting a wingless *Acræa esebria*, retreating before it when I continued to offer it. It was interesting that after this lapse of time she should continue to remember clearly the Acræine body and to associate it with a high degree of unpleasantness, for she was unmistakably hungry and would I feel sure have eaten a *Terias*, judging from the avidity with which she now accepted and swallowed down a *Mycalesis campina*. It is interesting in this connection to note that on my commencing the above experiment the roller was hopping about on the ground searching for food and picking up an occasional working termite. Nevertheless, she failed to see a solitary larval grasshopper which was lying motionless on the floor. She usually eats it right up to the end when offered by the forceps, yet now she passed over it two or three times without seeing it. I have noticed this difficulty in distinguishing motionless objects frequently before on the part, not only of the roller, but of my various other insectivorous birds, and one sees exactly the same thing in buck and other wild mammals. Had the grasshopper moved it would probably have at once been snapped up. I now fed the bird by hand and somewhat later in the day offered her a *Myc. campina* which she readily ate. She then accepted readily a *Pachnoda impressa*, but absolutely failed to eat it, as the beetle slipped with a snap from her bill each time she applied any pressure. She then ate readily three smallish grasshoppers, including the one that had been lying in the cage all day; refused, then tasted slightly and rejected a *Myc. campina*. I then reoffered the Cetoniid, but she again failed to crush it owing to its extreme slipperiness and toughness. She commenced by refusing it without tasting, but on my continuing to offer it, she made quite a number of attempts to crush it, sometimes succeeding in holding it in her bill while she struck it several times against the perch, but it always slipped out in the end and the bird finally refused to have anything more to do with it, edging away whenever it was offered. She then ate readily a *Eurytela hiarbas*, but refused and on persuasion tasted slightly and rejected a *Myc. campina*.

[*M. campina* preferred to *Z. elegans* and *A. esebria* (or whatever this was taken for); grasshoppers and *E. hiarbas* eaten after the bird had failed to eat *Pachnoda*. The defence afforded the latter by gloss and toughness was well illustrated; also the roller's memory and capacity for recognizing even a wingless Acræine body by the incident of the *A. esebria*.]

Exp. 110.—*November* 28. Hungry; she at first refused without tasting a *Pachnoda impressa*, evidently remembering her experience of yesterday, but on my persisting in offering it, accepted it several times in succession. It each time, however, slipped out of its bill and the bird only twice or thrice arrived at the stage of banging it against the perch—for she seemed to realize that this was the correct procedure here, crushing with the bill being out of the question. She finally refused to have anything more to do with it.

After an interval I offered her another Cetoniid, *Rhabdotis aulica*, a somewhat large metallic-green species. She at once accepted it, but only to go through once more the tantalizing performance which she had experienced in connection with the *Pachnoda*, with the result that the *Rhabdotis* too was soon given up as a bad job, the bird showing irritation whenever I brought it near to her. She then tasted and rejected a *Lytta designata*, but eagerly accepted and ate a *Eurytela hiarbas* and a *Mycalesis campina.*

[A good illustration of the value of the defences of gloss and toughness. *L. designata* placed below *E. hiarbas* and perhaps *M. campina.*]

Exp. 111.—*December* 1. Hungry; early morning; no food yet. Crushed and readily ate the Carabid beetle, *Polyhirma œnigma*, in spite of its strong, sour, vinegary smell; crushed and rejected the Chrysomelid, *Hemiphracta abyssinica*, readily ate a second Carabid, *Platynus* sp., refused, then tasted with hesitation and rejected a larva of *Epilachna hirta*, and refused to touch *E. hirta*, imago. After a great deal of persuasion, however, she tasted it slightly and rejected it.

[That is, the *Polyhirma* and the *Platynus* were preferred to the *Hemiphracta*, and quite likely also to the larva of *Epilachna hirta*, and to *E. hirta*, imago, and all these rejected insects were probably very much disliked, as the roller was very hungry.]

Exp. 112.—*December* 2. Tasted and at once rejected a Chrysomelid beetle, *Exosoma bimaculata*, and an *Aletis monteironis*, but ate with the greatest readiness a *Mycalesis campina.*

After a further interval without food I gave her a large black highly-polished Cetoniid, *Diplognatha gagates.* Though very hungry she completely failed to eat it. Time after time she accepted and attempted to crush it, or even got so far as to commence to batter it, but the beetle every time slipped from between her mandibles and shot across to the other side of the cage to the bird's intense annoyance. She then ate readily not only a *Myc. campina* but an *Aletis monteironis*, offered as before with all wings attached. She then once more went through the same performance with the Cetoniid and completely failed to eat it.

I then fed her up on grasshoppers till she persistently refused to eat another, although several favourite species were offered. I then thrust through the bars the *Diplognatha gagates* and used my utmost powers of persuasion to obtain its acceptance. The roller would, however, have nothing whatever to do with it, evidently not realizing—for the wings, too, are black—that it had been rendered easier to crush, but she readily ate a *Catacroptera cloantha* with all its wings attached, afterwards once more refusing to touch the Cetoniid.

[SUMMARY :—

1. *Myc. campina.* } *Cat. cloantha.*
Exosoma { 2. *Aletis monteironis.* }
bimaculata. { 3. *Diplognatha gagates* (complete failure)].

Exp. 113.—*December* 3. After a little hesitation tasted well and rejected an *Acræa johnstoni* with pale buff hindwing patch, and refused most persistently even to taste the larva of a Coccinellid, owing no doubt to its general likeness in form though not altogether in colour to that of *Epilachna hirta* with which she is already acquainted.

I then fed her on grasshoppers till she refused absolutely to touch another. Five minutes later she ate two more, both very small, and refused most persistently to accept another though I offered several species, but accepted, crushed, and very readily ate *Aterica galene* ♀ (one hindwing attached) and *Hypolimnas wahlbergi* ♀. She then refused *Papilio angolanus* without tasting, but on my continuing to press it on her accepted, crushed, and at once rejected it. This was repeated twice again, the roller being attracted back to it each time by the butterfly's violent fluttering, but after that she refused persistently to taste it again, moving away whenever I brought it near.

Ten minutes later she for a minute or two refused to taste *Pseudacræa lucretia*, a black and white ♀ with all wings attached, scrutinizing it closely and suspiciously sometimes, but each time withdrawing without actually trying it. At last, however, she accepted it, crushed it very thoroughly with a doubtful air and practically swallowed it (in good position, head first and wings well back), but at once brought it forward into the bill again and subjected it to a further tasting before finally eating it. She then refused but on my continuing to hold it to her crushed and rejected *Papilio angolanus* and refused a small grasshopper, but after a great deal of persuasion ate the latter and two more, both very small, besides persistently refusing to touch another, though as usual I offered several favourite species. She then refused for a time but eventually tasted slightly and dropped a moth (*Cœnina* ?), similarly refused but finally ate a ♀ *Arrugia basuta*, and most obstinately refused to touch either a second ♀ *Arrugia basuta* or a *Precis cebrene*, being evidently quite replete.

Ten minutes later she persistently refused the *Cœnina* moth, readily ate an *Anomala ustulatipes* and a ♀ *Arrugia basuta*, refused for a few seconds but then accepted and ate a second, readily ate a ♂ *Arrugia basuta* and a *Precis cebrene*, refused most obstinately to touch a *Papilio angolanus*, and refused for a time but finally, changing her mind, ate an *Anomala ustulatipes*. Ten minutes later she crushed rather doubtfully and ate a *Cœnina* moth and a *Precis cebrene*, but refused a ♀ *A. basuta* and a second *Precis cebrene*.

[SUMMARY :—(1) *Note* : "As I had no butterflies of the second class (*Papilio lycæus* or *demodocus*) to offer, it is impossible to say that one of these would not have been eaten at the moment at which I offered *Aterica galene* and *Euralia wahlbergi*. The contrast between the relish with which these two butterflies were eaten and the promptness with which *Papilio angolanus* was each time rejected would, however, indicate that neither were *less* liked than *Papilio lycæus* would have been, for the gap between the latter butterfly and *Papilio angolanus* is not at present great."

(2) *Probable order* :—

1. *Aterica galene*, ♀ *Anomala ustulatipes*, and perhaps *Arrugia basuta*, *Precis cebrene*, and *Hyp. wahlbergi*.
2. The better grasshoppers, the moth, and *P. angolanus*, the moth being finally eaten with doubt up to *cebrene* refusal-point.

3. The close inspection and very wary trial of the *Pseudacræa* was of rather special interest.]

Exp. 114.—*December* 4. Hungry; tasted and rejected *Mylothris yulei* ♂, *Aletis monteironis*, *Exosoma bimaculata,* and an ant (*Platythyrea cribrinodis*), but ate with the greatest eagerness *Mycalesis campina.*

After an interval, the bird receiving no food meantime, she readily ate after crushing it the *Mylothris yulei* (a ♂ with smell strongly developed), wings and all, crushed and rejected *Exosoma bimaculata* and *Platythyrea cribrinodis*, but ate, though with dislike and after an unusually prolonged crushing and battering, an adult ♀ locust, *Zonocerus elegans.*

[*Probable order* :—

Zonocerus { 1. *M. campina.*
elegans. { 2. *M. yulei.*
3. *Exosoma bimaculata* and *Platythyrea cribrinodis.*]

Exp. 115.—*December* 5. Tasted and at once rejected with disgust a beetle (*Lycus*); refused, then crushed and rejected a *Mylothris yulei* ♂, but without special signs of disgust; refused for a time, then tasted and rejected with disgust a larva of a Coccinellid, but eagerly ate a *Mycalesis campina* and, after distinctly tasting it, a *Tarucus plinius.* She then ate fifteen small grasshoppers in quick succession and, after them, readily, a second *Tarucus plinius* and another *Mycalesis campina*, also a small white moth. After seven more small grasshoppers she again readily ate a *Myc. campina*, and after five more refused for some seconds, then tasted and rejected an *Azanus moriqua*, but on my reoffering it again tasted and this time swallowed it. She then accepted and ate a *Mycalesis campina,* but treated a *Tarucus plinius* exactly as she had done the *Azanus*, eating it similarly in the end.

After three more grasshoppers she refused, then tasted and rejected both *Azanus moriqua* and *Tarucus plinius*, and afterwards refused obstinately to have anything more to do with them; refused a *Mycalesis campina*, then leant forward and nearly closed her bill on it, but withdrew without removing it from the forceps. Five minutes later she refused the *Myc. campina* with shakes of the head and clappings of the bill, tasted hesitatingly and rejected in turn *Lampides bœtica* and *Tarucus plinius*, and five minutes later persistently refused to taste either again.

Fifteen minutes later she refused obstinately to taste a *Nacaduba sichela*, though she once leant forward doubtfully and nearly did so; accepted doubtfully, but then ate with apparent relish a *Henotesia perspicua*, persistently refused to even taste a *Terias*, and refused for some seconds, then tasted slightly and hesitatingly and withdrew without actually accepting the *Nacaduba sichela.* She then ate in quick succession eight more grasshoppers before refusing to eat more—as usual I now offered several palatable species without succeeding in tempting her appetite,—persistently refused to touch *Catachrysops dolorosa* or a *Papilio angolanus*, but very readily accepted and ate an *Arrugia basuta* ♂.

The butterflies in the above experiment had all wings attached. The Lycænids were quite evidently disliked.

[*Probable order* :—

1. *Arrugia basuta.* } *Henotesia perspicua.*
2. Grasshoppers.

C. dolorosa (if recognized), *P. angolanus.* {
2. Grasshoppers.
3. *M. campina.*
4. *Azanus moriqua*, *Tarucus plinius.*
5. *M. yulei* (on manner).
6. *Lycus*, Coccinellid.

} *L. bœtica* & *N. sichela*, probably not appreciably if at all above *M. campina.*]

Exp. 116.—*December* 6. Fed on grasshoppers till she would eat no more; readily ate two winged termites, a Catocaline moth (*Ophiusa lienardi*) and a Rutelid beetle (*Adoretus* sp.), as also another termite; crushed and rejected an orange-banded Longicorn, *Cymatura bifasciata*, but readily ate yet another termite.

[*Probable order* :—

1. Termite, *Ophiusa lienardi*, *Adoretus* sp.
2. Grasshoppers, *Cymatura bifasciata.* The latter, however, was definitely tested only against the termite.]

Exp. 117.—*December* 7. Distinctly hungry. Crushed and at once rejected the Arctiid moth, *Diacrisia maculosa*, exuding juice from before thorax, as also an unidentified Coccinellid, refused persistently to taste *Epilachna hirta*, but eagerly accepted and ate a *Mycalesis campina* and a *Terias*, refused, then hesitatingly tasted, and withdrew without accepting an *Acræa caldarena*, and once more, this time after a more thorough tasting, rejected the *Diacrisia.*

I then fed her on various Orthoptera till she would absolutely eat no more. After this she refused for a time to accept *Papilio angolanus*, but finally just tasted a leg and withdrew with a shake of the head, then accepted with a certain amount of hesitation, due perhaps to its brilliant coloration, the front half of a full-grown larva of *Acherontia atropos* which I had that moment cut in two, but dropped it. This was probably, however, either the result of accident or of the surprise due to the sudden rush of its copious internal juices into the bird's bill, for on my reoffering it, it was readily accepted, crushed and battered against the perch and swallowed. The bird now refused without tasting an *Arrugia basuta* ♀, a *Catacroptera cloantha*, a *Catopsilia florella*, and a *Precis cebrene*, being to all appearance replete. She kept wiping her bill, however, at intervals and shaking her head, which I took to be possibly a sign that she regretted having eaten the larva (though it may have been simply a matter of its juices), so fifteen minutes later I offered the other half. The bird looked at it and sidled up towards it from the other end of the perch, but did not at once accept it, leaning forward on arrival but then drawing back once more with a shake of the head. A few seconds later she tasted it half-heartedly and again drew back without having accepted it. She then refused, but changing her mind accepted, crushed and ate a *Catacroptera cloantha*, but refused persistently to taste a *Precis cebrene* or a *Catopsilia florella*, being evidently too replete for them.

The "death's-head" larva evidently continued to tempt her nevertheless, for on my now at once reoffering it she once more leant forward and closed her bill on it, but did not take it from the forceps. She then again persistently refused to accept a *Precis cebrene* and crushed slightly and tossed aside an *Adoretus*.

Somewhat later by lamplight the roller very persistently refused with shakes of the head to have anything to do with *Papilio angolanus*, readily accepted and ate an *Arrugia basuta* ♂, accepted equally readily, crushed and battered well and swallowed the remaining half of the death's-head larva, crushed and threw aside an *Adoretus*, and refused without tasting a ♀ *Arrugia basuta*.

[Summary :—(1)

Arrugia basuta.	1. *C. cloantha*, slightly above 2. *Acherontia* larva, which was eaten to refusal-point for *Arrugia*, *C. florella*, *P. cebrene*.
Adoretus (prob.).	3. *P. angolanus*.

M. campina and probably the *Terias* were preferred to *Diacrisia maculosa*, which, on the manner of its last refusal, was perhaps preferred to *A. caldarena* and the two Coccinellids.

(2) *Note*: "The refusals of *Papilio angolanus* were very decided and final, and there can be therefore no escape from the conclusion that the larva was no more unacceptable to the roller than is *Papilio lyæus*, possibly less so. I confess that I was surprised in view of its coloration.

The *Diacrisia* is quite likely on a level with *Nyctemera*—it is certainly markedly less unpleasant than *Acræa caldarena*."]

Exp. 118.—*December* 9. Very hungry, tasted and rejected *Acræa igola* and *Acræa johnstoni*, refused without tasting an adult *Zonocerus elegans*, and tasted and rejected the same locust in the larval stage.

Exp. 119.—*December* 10. Ate a large number of grasshoppers, but at last refused persistently to touch any more, and refused with equal obstinacy, without tasting it, a *Papilio demodocus* with wings attached. She quite readily however accepted, barely crushed, and at once swallowed an Acræoid Lycænid, *Catochrysops peculiaris*. She then definitely tasted and rejected the *Papilio demodocus*, and, on my removing and offering the abdomen alone, tasted it too and rejected it. She then examined a *Hypolimnas wahlbergi* with one wing attached with an air of doubt and then withdrew and for a long time would not taste it. Finally she did so, slightly and with hesitation, and dropped it, then with the greatest readiness accepted, crushed and ate *Precis tugela* with one forewing attached. She then once more refused, but, changing her mind, tasted the *Hypolimnas wahlbergi* and rejected it, readily accepted and ate *Hamanumida dædalus*, refused again, then tasted, this time much more thoroughly, and rejected the *Hypolimnas wahlbergi* (she crushed it repeatedly with an air of uncertainty, as though undecided whether to eat it or not), but readily ate a *Catacroptera cloantha*, again refused *H. wahlbergi* for a second, then leaning forward took an antenna in her bill and withdrew with a slight shake of the head, readily ate a dead but supple *Catochrysops parsimon*, refused obstinately to taste *Hypolimnas wahlbergi*, readily accepted, crushed and ate a *Precis artaxia*, refused, then tasted well *H. wahlbergi*, being again quite obviously uncertain whether to eat it or not, but ended by once more rejecting it, though she readily ate a *Charaxes achæmenes* and a ♂ *Arrugia basuta*.

Ten minutes later she refused the *Euralia wahlbergi* for a second or two, then crushed and rejected it, and crushed well and rejected the Longicorn beetle, *Cymatura bifasciata*. She then suddenly noticed a *Mutilla* that was climbing up the side of the cage and leaning over seized it, the ant making no attempt to escape, crushed it—its strong smell reached my nostrils two or three feet away as she did so,—and threw it away.

Fifteen minutes later she crushed and ate *Papilio demodocus*, tasted and rejected the *Cymatura*, refused, then merely took and threw aside *Hypolimnas wahlbergi*.

Five minutes later she tasted and hesitatingly dropped *H. wahlbergi*, refused, then tasted perfunctorily and rejected a *Mycalesis campina*, crushed and swallowed a *Papilio angolanus*, the *H. wahlbergi*, and a *Catachrysops dolorosa*, refused to touch a *Mycalesis campina*, refused, then tasted unwillingly and rejected a *Papilio angolanus*, subsequently refusing obstinately to taste it again, crushed well and doubtfully and finally ate the *Cymatura*, and once more persistently refused to have anything to do with *Papilio angolanus*.

[SUMMARY :—

(1) If we take manner freely into account we have the order :—

1. *C. peculiaris*, *C. parsimon*, *A. basuta* ♂, *P. tugela*, *P. artaxia*, *H. dædalus*, *C. cloantha*, *C. achæmenes*.
2. *P. demodocus*. *Cymatura bifasciata* not above it.
3. *P. angolanus*.
4. *H. wahlbergi* (*might* have gone higher, but for special suspicions).
5. *M. campina*, *Mutilla* sp.

(2) Against the above suggestions concerning *H. wahlbergi* we have the following note, made at the time of the experiment :—

"The bird had thus accepted and eaten the *Hypolimnas wahlbergi* exactly at the *Papilio angolanus* point—at the moment when she could just bring herself to eat a single *Papilio angolanus*,—but not a second. That is to say, the Nymphaline was placed on a level with *Papilio angolanus*. I doubt whether this result was due to any appreciable extent to the latter's resemblance to *Amauris dominicanus* (it had a hindwing attached); it seems more likely (and accords with the fact that the roller's tastings of it were characterized by hesitation) that though thoroughly palatable this butterfly is slightly unwholesome and that the roller retained a memory of its effects on itself on previous occasions."

I also recorded that I regarded *C. peculiaris* as having been hardly sufficiently tasted for a sure result.

Exp. 120.—*December* 12. I fed the bird on grasshoppers till she began to accept and eat them with distinct disinclination. She then accepted a brightly coloured bug, *Cryptacrus comes*, crushed it well, shaking her head greatly all the time, though with long sweeps, as though to get her nostrils clear of the strong bitter-almond stench, and swallowed it. Her behaviour reminded me of that shown previously in connection with a Coreid bug, when I compared it to a person swallowing a rather *too* strong liqueur. She then refused two dull-coloured and usually highly acceptable grasshoppers.

Ten minutes later she ate six or seven small grasshoppers before refusing to eat any more, and then would also have nothing to do with a second bug of the same species.

[This bug was probably placed quite as high as, e. g., *P. angolanus.*]

Exp. 121.—*December* 13. I fed the bird on grasshoppers till she refused absolutely to eat any more. She then persistently refused *Papilio angolanus* without tasting and with shakes of the head, tasted and rejected a ♀ *Papilio echerioides*, dead but supple, again refused with shakes of the head the *Papilio angolanus*, but readily accepted and ate, the second slowly, two moths, both *Ophiusa lienardi.* She then crushed and held for some seconds the large common brown Asilid, *Alcimus rubiginosus*, simply however through comparative repletion, for she then swallowed it without sign of dislike, as also the moths *Spirama capensis* (Catocaline), *Ægocera fervida* (Agaristid), *Cyligramma latona* and *Nyctipao macrops* (both Catocalinæ). The *Ægocera* received a longer crushing than the others, and was practically swallowed once and brought up again before being finally swallowed. That it was eaten at all a little surprised me, for it possesses a strong smell of its own which I have always taken to be the outward and tangible sign of some inward and unpleasant properties.

The huge *Nyctipao*, which I offered without wings, on the first—careless—acceptance succeeded, in struggling to escape, in driving its very sharp spines into the bird's lore and was at once hastily dropped. On my reoffering it it was accepted quite readily, but the bird this time took the precaution of seizing it firmly right across the thorax and crushing it at once. She was now utterly replete and refused persistently even to taste *Precis cebrene, Catopsilia florella*, and *Ophiusa lienardi.*

Twenty minutes later she accepted with hesitation, crushed and rejected the foreleg of a rat (*Mus decumanus*), refused without tasting *Papilio angolanus* and *Papilio echerioides* ♀, but readily ate *Precis cebrene.*

[SUMMARY :—

1. *Ophiusa lienardi* (and, in so far as not merely the result of stimulation, *Alcimus rubiginosus*, *Spirama capensis*, *Cyligramma latona*, and *N. macrops*) to *cebrene*, etc., refusal-point.

P. echerioides ♀, leg of *Mus decumanus*, and perhaps in view of its first escape through an effective use of its spines, *Nyctipao macrops.*

2. *Ægocera fervida* (on manner: eaten probably as a result of stimulation).
3. *P. angolanus*, grasshoppers.]

Exp. 122.—*December* 14. Crushed and readily ate a *Cryptacrus comes*, shaking her head as before, apparently to avoid the smell, and after swallowing it remained with her bill wide open as though to let it escape. Ten minutes later she tasted and at once flung right away an *Acræa asema*, but readily ate a *Mycalesis campina* and a second bug, and, ten minutes later again, yet another bug—once more with no real sign of dislike. She then looked puzzled over a piece of raw "Zwidata" (*Plectranthus tuberosus*), a native vegetable that is not unlike a Jerusalem artichoke, but accepted, tasted it well, and readily swallowed it.

Later, happening to catch an ichneumon in my hand—*Osprynchotus flavipes* ♂—I offered it to the roller. She tasted and at once rejected it, the ichneumon flying off unharmed, but she crushed and readily ate a *Cryptacrus comes*.

[*M. campina* and *Cryptacrus comes* would appear to have been preferred to *A. asema* and *O. flavipes*. The eating of the bit of *Plectranthus* root was interesting in connection with the question of instinctive recognition of food.]

Exp. 123.—Later experiment. Ate several small grasshoppers, a *Cryptacrus comes*, a *Mycalesis campina*, five more small grasshoppers, a *Mycalesis campina*, a *Cryptacrus comes*, two more small grasshoppers, and again a *Myc. campina* and a *Cryptacrus comes*, three more small grasshoppers, and again a bug, but refused, then changed her mind, and ate a *Mycalesis campina*, then one large grasshopper, after which she refused to eat any more grasshoppers though I offered several, but again readily ate a *Mycalesis campina* and another bug, as also after great crushing and battering a large Saturniid, *Gynanisa ethra*. She then once more refused to eat grasshoppers, but readily ate a *Sphingomorpha chlorea*, refused to have anything to do with a *Myc. campina*, but ate after much crushing—indicative probably of hesitation or disinclination—another large *Cryptacrus comes* (white form) and again refused to taste a *Myc. campina*. She nevertheless accepted and ate a dead *Papilio angolanus*, but once more refused grasshoppers and this time another of the bugs.

[*Order* :—

Red *Cryptacrus comes*,
Sphingomorpha chlorea,
Gynanisa ethra.
1. *P. angolanus*, *Cryptacrus comes* (white form).
2. *M. campina*.
3. Grasshoppers.]

Exp. 124.—*December* 18. Hungry. Tasted and at once rejected a Phytophagous beetle.

Exp. 125.—*December* 20. Hungry; refused obstinately to taste a Phytophagous beetle, crushed very thoroughly, obviously half tempted to swallow it, then rejected a Meloid, *Epicauta thoracica*, readily ate a *Myc. campina*, tasted and at once flung away a moth, *Olapa nuda*, tasting it more hesitatingly and again flinging it away on my reoffering it, and once more subjected an *Epicauta* to the same prolonged tasting as before, before finally rejecting it. These Meloids had only just been captured close by, so would presumably still retain their objectionable qualities in full strength. They seemed to be far less unacceptable (whatever their after-affects may be) than the Lymantriid moth.

[*Order*:—1. *M. campina*. 2. *Epicauta thoracica*. 3. Phytophagous beetle and *Olapa nuda*.]

Exp. 126.—*December* 21. I fed the roller on grasshoppers till she absolutely refused to touch another. She then tasted and rejected *Papilio angolanus*, crushed very thoroughly indeed and ended by rejecting a large ♀ *Gynanisa ethra* (though alive 18 hours before, it was now dead and even, I thought, beginning to smell very slightly), refusing to taste it again on its being reoffered, but crushed and ate very readily a large conspicuous Asilid with a comparatively slow flight, *Microstylum validum*.

[*M. validum* preferred to *Gynanisa ethra* ♀, *P. angolanus*, and grasshoppers.]

Exp. 127.—*December* 24. Refused obstinately to taste a *Terias*, readily accepted and ate a *Myc. campina*, once more refused the *Terias*, and went on to eat no less than eighteen *Myc. campina*, the last few with increasing disinclination. The nineteenth was obstinately refused, but four *Papilio angolanus* were readily eaten, the fifth refused without tasting; a *Myc. campina* refused, then tasted and rejected, and another *Papilio angolanus* taken listlessly and tossed aside. The bird then crushed very thoroughly and ate without apparent dislike a large ♂ *Gynanisa ethra*, refused a *Precis cebrene*, took listlessly, crushed and held, but finally tossed away a *Catacroptera cloantha*, threw away a usually much-liked grasshopper, refused *Catopsilia florella* without tasting, as also a grasshopper of another favourite species, then leant forward as though inclined to accept the mate of the previous Saturniid, a large gravid ♀, but I withdrew it, wishing to reserve it for breeding.

[*Order* :—

1. *Gynanisa ethra* ♂. } *Gynanisa ethra* ♀ probably slightly *preferred* to *P. cebrene*, *C. cloantha*, *C. florella*, and the grasshopper.
2. *P. angolanus.* }
3. *M. campina.*
4. *Terias.*]

Exp. 128.—*December* 27. Tasted and rejected a *Terias*, then refused it without tasting, but readily ate in succession no less than thirty-one *Papilio angolanus*, each with one hindwing attached, the last five or six with increasing and, in the end, marked disinclination. The thirty-second was just taken and tossed away and then refused persistently without tasting. The roller then twice crushed well and finally rejected *Papilio demodocus*, refused *Terias* without tasting (the first *Terias* had been reoffered in amongst the first few *angolanus* and was at once swallowed, whether inadvertently or otherwise it was impossible to say), readily ate, wings and all, a *Precis cebrene* and a *Catacroptera cloantha*; refused even to taste *Catopsilia florella*, readily ate another *Precis cebrene*, persistently refused to taste *Papilio angolanus*, refused, then tasted and rejected *Papilio demodocus*, readily ate two brown Hepaliid moths (*Gorgopis*) and the *Catopsilia florella*, tasted again and rejected *Papilio demodocus*, readily ate a ♂ *Arrugia basuta* and a *Precis ceryne* ⊙ f., and battered and broke into three a large ♀ Saturniid with one wing, gravid (*Gynanisa ethra*, Westw.), the pieces falling to the ground. I reoffered the thorax, which was well crushed and readily swallowed. The bird then refused to have anything to do either with the whole abdomen after crushing it carefully or with a very small piece of it, but readily ate a *P. cebrene* and again refused without tasting the small piece of abdomen. She then refused for a second, but changing her mind accepted, though with marked disinclination, a common grasshopper that she usually accepts amongst the last, crushed it and threw it away, and refused even to taste several others of different species which I now offered her, yet she very readily ate a *P. cebrene.*

More than half an hour later she readily ate a *P. angolanus* and the *Gynanisa* abdomen full of eggs, but then refused to taste a second *P. angolanus* or the *P. demodocus.*

[*Apparent order*:—

A. basuta ♂, and, if not merely through stimulation, *P. ceryne* ⊙ f., and *Gynanisa ethra* (thorax).
1. *P. cebrene*, brown Hepialid (and *C. cloantha*?).
2. *C. florella* (if not eaten through stimulation).
3. *P. demodocus.*
4. *P. angolanus.*
5. *Terias.*

The abdomen at any rate of the *Gynanisa* was placed *below P. cebrene.*]

Exp. 129.—*December* 28. Ate very readily indeed several smallish pieces of the whitish meat of a leopard and refused the last, but readily ate a *P. angolanus* and a *Cymatura bifasciata.* She then refused without tasting a portion of a frog with skin attached.

Later I noticed that she had brought up the meat quite undigested in the form of two large pellets, also the *Cymatura.* The beetle was lying by itself untainted by the meat and may of course have been brought up on its own merits. I could find no trace of the *P. angolanus.* If brought up it may have been picked out and swallowed again (*cf.* observation on *Bucorax cafer*).

Several hours after the above experiment I fed the bird up on grasshoppers until she obstinately refused to eat any more, though several favourite species were offered. She then accepted, crushed and ate a *P. angolanus*, wings and all, with a certain amount of disinclination and persistently refused the next without tasting. Yesterday's *P. demodocus* was dead and the thorax slightly dry, abdomen quite damp and supple. I therefore removed the latter and holding the butterfly's hindwing against it offered it, but the bird at first refused it, then leant forward with disinclination, took and dropped it, crushed and at once threw away a *Cymatura bifasciata*, crushed thoroughly and swallowed a *Polyhirma ænigma*, crushed well and rejected *Bostrichoplites cornutus.* She was now shaking her head and clapping her bill, possibly, I thought, in regret for having eaten the Carabid (which was smelling appreciably, though not its strongest, when swallowed). I therefore waited until she had once more recovered her usual calm demeanour—a matter of a few minutes—and offered a Lycoid Lygæid bug.

This was tasted and at once flung away as were also a red millipede (*Spirolobus* sp.) and once more the Bostrychid. A water-bug, *Laccotrephes ater*, L., was then accepted with an air of puzzledom, turned in all directions, and crushed in every conceivable position. Its leathery hide—for that is the only term to describe it—

at once resumed its former shape each time the pressure was relaxed, the bug remaining absolutely motionless with walking-legs all stretched stiffly back under the protection of the abdomen, and claspers stretched stiffly forward but ready to suddenly clasp at whatever came within reach. By thus unexpectedly grasping the wires of the cage the bug was several times wrenched right out of the roller's bill and the latter, heartily annoyed, apparently, by this leathery object that kept catching in everything, at last flung it away in a rage and refused obstinately to take it again. She then seized a smallish Coprid with hard rounded glossy elytra, *Copris orion* ♀, but the beetle at once slipped out of her grasp. She refused to accept it a second time or an *Amiantus globulipennis*, crushed well and threw right away the Lycoid bug, accepted a dark green bug (*Cryptacrus comes* var. *apicalis*, Dist.), which slipped out of her grip the first time (it is harder than *Cryptacrus comes*), but was easily enough crushed on being reoffered and eaten with apparent relish in spite of its strong smell, which it was obvious was noted by the bird. She then went on once more to crush and reject the Bostrychid and to refuse without tasting the *Cymatura* and the water-bug, the Coprid, a *P. angolanus*, and the *P. demodocus*, but to accept and eat most readily a *P. cebrene*.

[*Order* :—

1. *Polyhirma ænigma* (regretted ?), *Cryptacrus comes* var. *apicalis*, *Precis cebrene*.

Bostrichoplites cornutus, Lycoid bug, Red Millipede, *Laccotrephes ater*, *Copris orion* ♀ and probably *Amiantus globulipennis*. }
2. *Papilio angolanus*, *P. demodocus* (on manner).
3. Grasshoppers, *Cymatura bifasciata* (on manner).

P. angolanus and perhaps the *Cymatura* were eaten in preference to the leopard's meat before this had yet disagreed. With its evident disagreement may be compared the fact that it was only eaten by my carnivorous animals under stress of hunger.

The *Polyhirma*'s special defence had probably been much reduced by capture; the Lycoid bug was rejected more emphatically than the Bostrychid; the special defence of the *Laccotrephes* and the *Copris* are worth noticing, as also the fact that *Cryptacrus comes* var. *apicalis* is harder and so distinctly better protected against enemies in the manner shown by the experiment than typical *Cryptacrus comes*. I have always regarded them as distinct species.]

Exp. 130.—*December* 29. Persistently refused even to taste a *Laccotrephes ater*, but readily ate a *P. angolanus*, a *Mycalesis campina*, and a *T. brigitta*.

[This places the water-bug relatively to the roller below *P. angolanus*, if not below *T. brigitta*, apparently mainly if not entirely in virtue of its leathery covering.]

Exp. 131.—*January* 7, 1910. *To place Herpænia eriphia and Teracolus phlegyas.* After several grasshoppers, readily ate a *Mycalesis campina*, two large grasshoppers, another *Mycalesis*, a *P. angolanus*, and a *Teracolus phlegyas*, yet another grasshopper and three more *Mycalesis*. The next grasshopper was held for some time and occasionally crushed before being finally swallowed, and the bird treated in the same way a *Mycalesis campina* and a *Papilio angolanus.* She then most obstinately refused to touch a *M. campina*, shook her head four or five times on being shown a *Teracolus phlegyas*, but nevertheless accepted, crushed slightly and swallowed it, again persistently refused to touch a *Mycalesis*, finally tasting it slightly and rejecting it, refused an *H. eriphia*, then barely closed her bill on an antenna and withdrew, refused with equal obstinacy a *P. angolanus*, refused in turn for a second or two, but changing her mind accepted and crushed and swallowed a *C. florella*, a *Teracolus phlegyas*, and an *H. eriphia*, again most obstinately refused *Mycalesis* and *P. angolanus*, but readily accepted a *Catopsilia florella.* The butterfly was seized only by a hindwing and on the bill cutting through this escaped and, finding an opening in the wire of the cage, flew away. The bird then accepted a *C. cloanthe* with actual *eagerness* and at once swallowed it wings and all. Most of the butterflies in this experiment were offered with wings. She then persistently refused to touch any sort of grasshoppers, *P. angolanus* or *M. campina*, readily ate two of the termite-nest grubs disliked by the warblers, crushed well and rejected *P. lyœus*, refused without tasting a Lycænid with two wings attached and a *Spindasis natalensis.*

Five minutes later she readily ate a dead but fairly supple *H. eriphia*, but refused without tasting the *P. lyœus.*

Twenty minutes later she readily ate the Lycænid, but went on to eat also a *Mycalesis campina* and a *P. angolanus.*

[*Order* :—

T. phlegyas. { 1. *C. florella*, termite-nest grubs, and possibly *C. cloanthe* and *H. eriphia.*
Grasshoppers. { 2. *P. angolanus.*
3. *M. campina.*

H. eriphia probably above *P. angolanus*; and *P. lyœus*, at any rate, not *preferred* to *H. eriphia.*]

Exp. 132.—*January* 8. Tasted and rejected a *Zonocerus elegans* ♀, refused persistently to have anything to do with *Nychitona medusa*, tasted and doubtfully rejected a *Mylothris yulei*, crushed and threw away *Olapa nuda*, crushed and readily ate a *Terias senegalensis*, refused a saw-fly larva that is destroying the turnips, then tasted it with evident suspicion and threw it away. Its habits are quite conspicuous and its coloration, though very dull, is in contrast to the leaves it feeds on.

A little later after feeding on grasshoppers she accepted and ate four *Mycalesis campina* with two or three grasshoppers between each, the last two *Mycalesis* after at first refusing them. She then held a grasshopper for some time in her bill, crushing it occasionally, and finally threw it away, refused all others persistently without tasting, as also a *Mycalesis campina* and a *P. angolanus*, crushed and readily ate an *E. hiarbas*, again refused *P. angolanus* and accepted, but after crushing it threw away an *E. hiarbas*, eating, however, a *C. florella*.

[*Probable order*:—

1. *Catopsilia florella.*
2. *Eurytela hiarbas.*
3. *Papilio angolanus, M. campina,* grasshoppers.
4. *Mylothris yulei*, on manner above
5. *Zonocerus elegans* ♀, *N. medusa, Olapa nuda,* and the saw-fly larva.]

Exp. 133.—*January* 9. Offered a wasp, *Dielis 5-fasciata* var. *mansueta.* She at once accepted it, but failed to crush it at first trial, and the wasp at once escaped on the roller's relaxing her hold to bite again. The next wasp also escaped. The bird, in trying to prevent its escape, managed to get it rather far back in her bill and at once brought it hastily forward to the tip, when she again failed to crush it —it is a distinctly hard insect. A third having escaped in the same way, I offered the next with its two wings on one side cut off. But even this was dropped three or four times. Like its predecessors it stung furiously and continuously against the bird's hard bill while being held, and it seemed to me that the roller did not dare to bring it further back in her bill as she would have done an ordinary insect. The result was that, on her failing to crush the wasp at the first or second trial, she would either drop it completely or the insect, being held so near the tip, would escape on the roller's hold being momentarily relaxed to bite. Once it entered the bill abdomen first, but was at once rejected and no harm seemed to have resulted. The roller never followed it up when it fell, simply looking down at it lazily from her perch, so that I had to secure and reoffer it each time. On about the fifth occasion the roller cracked the insect's thorax at the first attempt, and at once abandoning all her previous caution merely ran it three or four times lengthwise through her bill as carelessly as she would have done a grasshopper, crushing it well as she did so, then turning it head foremost swallowed it. The bird evidently realized the danger from the sting, and her whole attention had been devoted each time to at once crushing the thorax of the insect in the point of her bill and especially to avoiding bringing it far back in the mouth. Once the thorax was crushed, she realized that there was little or no further danger.

She then tasted and at once rejected a *Galerucella triloba*, Fabr., and its larva and refused without tasting two species of *Mylabris* (*M. oculata* and *M. omega*, Mars.).

She was distinctly hungry, however, and made a huge meal off various Orthoptera and other insects which I now placed in the cage. Later on she crushed well and threw right away a Psychid larva enclosed in its usual caddis-like covering.

Exp. 134.—*January* 9. Later in the day:—

To ascertain whether *Discolia alaris*, Sauss., and *Dielis 5-fasciata* var. *mansueta* are unwelcome apart from their stings and the Psychid apart from its covering.

Was fed on grasshoppers till she refused to eat any more. She then equally persistently refused to touch a *P. angolanus* and crushed well and rejected a *Discolia alaris.* Only ten minutes later, however, she readily ate the *P. angolanus*, twice crushed and rejected the black wasp (*Discolia*), readily ate another *P. angolanus* and a *Mycalesis campina*, refused the *Discolia* persistently without tasting, readily ate an ant-heap larva, and crushed and rejected a *Dielis* 5-*fasciata* var. *mansueta*. No fear had been shown of the wasp.

Five minutes later she again crushed thoroughly and threw away both wasps, refused persistently without tasting a very hairy Arctiid larva, ate four grasshoppers and refused the next three, but readily ate a *P. angolanus*, ate four more grasshoppers including those previously refused, crushed well and threw away *P. angolanus*, approached with suspicion the Psychid larva with "house" removed, tasted it slightly and rejected it, refused persistently to take the Arctiid larva or the Psychid larva reoffered. By no means yet replete.

[*Probable order*:—

1. Grasshoppers, *P. angolanus*, *M. campina*.
2. *Discolia alaris*, *Dielis* 5-*fasciata* var. *mansueta*, Arctiid larva.

The Psychid larva deprived of its covering was offered and rejected when *P. angolanus* was being refused, but the bird was still by no means replete.]

Exp. 135.—*January* 11. Readily ate one *Mycalesis campina* and three *Formicaleo leucospilus*, first crushing each slightly, pressed two or three times in her bill and flung right away a brilliant red millipede (*Spirolobus* sp.), crushed and rejected a small blue-black Phytophagous beetle, very readily ate another adult ant-lion, crushed and at once rejected a large green and yellow Phytophagous beetle, *Diacantha petersi*, readily ate a *Mycalesis campina*, crushed very thoroughly and finally rejected the dull bronze-green beetle, *Lagria villosa*, and readily ate another ant-lion. I then gave her a number of grasshoppers, after which she crushed well and rejected the ant-lion, accepted and ate a *Mycalesis campina*, took in the point of her bill, crushed slightly, and rejected an ordinary unswollen tick of our commonest species (*Rhipicephalus* sp.), ate five more grasshoppers large and small, the last three with disinclination and refused obstinately to touch any more, refused with equal obstinacy *Mycalesis campina* and *P. angolanus*, crushed thoroughly and threw away an Asilid fly, *Alcimus rubiginosus*, and crushed and flung away a Muscid fly that, sombre enough in colouring, is conspicuous through its habit of settling on the upper surface of large leaves in the forest; it seemed to me that she liked it less than the Asilid. She then refused even to taste an ant-lion, crushed well and rejected *P. lyæus*, first with wings, then without, readily accepted and ate *P. cebrene*, crushed well and rejected *E. hiarbas*, accepted a large *E. neophron* ♀ with all its wings attached, held it for a minute or two in her bill, crushing it at intervals, then tossed it away. As the action was indicative of disinclination rather than of dislike, I at once removed three of the wings and reoffered it, when it was at once readily crushed and eaten. The bird then accepted a *C. florella* with disinclination, crushed it, and dropped it.

Five minutes later she refused *Pap. lyæus* without tasting, readily ate two *Precis artaxia* ⊙ f. and a *C. cloanthe* (this was held for a minute or two, the bird being replete), and then refused without tasting *C. cloanthe*, *P. artaxia*, *C. florella*, and *P. cebrene*.

[*Probable order*:—

1. *Precis cebrene*, *P. artaxia* ⊙ f., perhaps *C. cloanthe.*
2. *Alcimus rubiginosus* and *Papilio lyæus.*
3. *M. campina*, grasshoppers.

P. angolanus,
Muscid fly,
E. hiarbas.

4. *Formicaleo leucospilus.*
5. *Lagria villosa*, on manner above
6. Scarlet millipede, Phyt. beetle 122, *Diacantha petersi.*

Cattle tick,
unbloated.

Exp. 136.—*January* 12. Crushed and ate a small green Phytophagous beetle (no smell and no exudation), refused, then tasted very slightly, and again refused a *Mylabris oculata*, definitely crushed and rejected another *Mylabris*, retreated from a ♀ *Zonocerus elegans* with very evident annoyance at its smell (sharp head-shakings, etc., which she at once indulged in whenever I brought it within two or three inches), refused persistently without tasting un undetermined beetle, crushed and threw away a bug, *Lygæus swynnertoni*, reached hesitatingly toward a large black millipede (*Spirostreptus* sp.), but retired with some slight display of horror on its commencing to squirm in the usual semi-spiral fashion, refused for a second, then tasted and rejected *Epilachna hirta*, refused persistently without tasting an *Aulacophora* sp., which doubtless reminded her of it, crushed thoroughly and ate a huge black Locustid of sluggish and conspicuous habits (*Mimnermus* sp.), and persistently refused without tasting a larval *Zonocerus elegans.*

Perhaps twenty minutes later she refused for a time, then, on my continuing to present it, definitely tasted and rejected the *Aulacophora*, which smells as strongly as any other of our Phytophaga, and accepted a small portion of the above-mentioned black millipede; but on her exerting pressure it slipped from her bill, being very hard and glossy. I therefore crushed it and reoffered it, when it was subjected to somewhat prolonged crushing and thrown away.

[The *Mimnermus* was preferred to the other insects used before the interval, and the millipede, after it, was shown more consideration than the *Aulacophora*. Its main defence, consisting in the emission of a pungently-smelling secretion, was doubtless lacking in the mere fragment offered.]

Exp. 137.—At noon, distinctly hungry once more, she did her best to crush a weevil (No. 128), even battering it well against the perch, but failed to make the least impression on it, and finally threw it away. She re-accepted it, but again failed to crush it though pressing with all her force, and threw it away, refusing to touch it again. However, she readily accepted, crushed, and swallowed another weevil (*Iphisomus* sp.), tasted and rejected a Chrysomelid, *Cladocera femoralis*, and crushed and swallowed *Horatopyga* sp. (similar but duller), readily ate after crushing it thoroughly a mantis egg-case and a *Mycalesis campina*, persistently refused to taste a *Mylabris oculata* or a ♀ *Zonocerus elegans*, and accepted doubtfully but then readily ate two fully gorged ticks of our commonest species.

[The *Iphisomus* was eaten readily and easily when 128 had proved impossible; the mantis egg-case, *M. campina*, and full-fed ticks were placed above *Cladocera* *femoralis*, *Horatopyga*, and weevil 128, and the ticks over *Mylabris oculata* and *Zonocerus elegans*.]

Exp. 138.—In the evening I fed her on grasshoppers, etc., until she obstinately refused to touch another or a *P. angolanus*, but readily accepted, crushed and ate a weevil (*Iphisomus* sp.). A small Cetoniid, *Leucocelis ichthyurus*, did not crush easily, so was tossed away, but a Longicorn, *Cymatura bifasciata*, with pale yellow bars was subjected to a very prolonged crushing indeed and finally swallowed. The bird now became restless, moving up and down the perch and from one perch to another and frequently shaking her head. It seemed to me that she possibly regretted the acceptance of the *Cymatura*, but I had unfortunately not another to offer. It is noteworthy in any case that she accepted the *Cymatura* so readily, though she had when much hungrier refused *Mylabris oculata*; evidently such resemblance as exists between those two insects is only calculated to deceive at a distance. The bird then refused without tasting a cockroach and *P. cebrene*. She retained the appearance of being perturbed.

Ten minutes later, as she had settled back into her usual somewhat lethargic state, I reoffered the cockroach, which was crushed well and thrown away, the bird going on to eat with the greatest readiness an *Iphisomus*, a *P. cebrene*, and even a *P. angolanus*.

[The *Iphisomus* and *Cymatura bifasciata* (if not regretted) were preferred to the bitter grasshoppers, to *P. angolanus*, and to *Leucocelis ichthyurus*, and the weevil at any rate was preferred also to the cockroach.]

Exp. 139.—*January* 14. Refused for a time, then tasted and rejected a driver-ant (*Dorylus* sp.) and thrice accepted an isopod, rolled up in a glossy, hard, black ball, which each time shot away from her bill as soon as pressure was applied. After the third failure she refused to touch it again, eagerly ate a *Mycalesis campina*, refused, then tasted, and at once rejected a *Mylabris oculata*, refused a *Zonocerus elegans*, showing a marked dislike to its smell whenever I brought it near.

She was now on an unaccustomed perch with no enlarged opening in the wire opposite for the admission of large offerings, and, as I could not tempt her away by showing it at the usual place, I had difficulty in getting to her a large dung-beetle, *Catharsius rhinoceros* ♀. On my dropping it from above she cleverly caught it in falling, but it slipped from her bill on her commencing to crush it, and I could not induce her to catch it again.

She then tasted and rejected *Alesia bidentata*, accepted a large *Xanthospilopteryx superba* with no smell at all, and subjected it to unusually prolonged crushing, in the course of which she several times half swallowed it, but at once brought it forward into the bill again and tasted it with redoubled care. Finally, after nearly swallowing it, she brought it up for the last time and threw it away and refused to taste it again. On my reoffering it with wings removed it was accepted, but evidently recognized by taste and was once more thrown away and ignored on re-presentation. The bird then refused a *Mylabris* (No. 22), but on my continuing to offer it tasted and rejected it, persistently refused without tasting a *Zonocerus* *elegans* ♀, showing the usual suspicion of its smell, accepted, crushed and ate a small Cetoniid, *Leucocelis ichthyurus* (it slipped out of the point of the bill the first time, but on being re-offered was taken more firmly and easily crushed), readily accepted and swallowed a *Mycalesis campina*, and crushed without difficulty and ate a *Copris orion* ♂. It was rather a large specimen with an unusually projecting horn, and though it was seized well back in the mouth with the horn pointing upwards no sign of discomfort was shown during the crushing process.

[*M. campina*, *Copris orion* ♂, and *Leucocelis ichthyurus* were preferred to *Dorylus*, the isopod, *Zonocerus elegans* ♀, *Mylabris* 22, *M. oculata*, *X. superba*, *Alesia bidentata*, and *C. rhinoceros*, though *M. campina* and *C. orion* can perhaps hardly be regarded as fairly tested against any but the first two of these, and the *Catharsius* should have been further tried. The *Xanthospilopteryx* was at least far less *obviously* unpleasant than the others.]

Exp. 140.—*January* 25. Tried and rejected with signs of dislike two Phytophagous beetles, *Megalognatha rufiventris* and *Exosoma suturale*.

Exp. 141.—*January* 31. Very hungry indeed. Three or four times seized an *Anachalcos spectabilis*, but it each time slipped from her bill and she refused with an air of irritation to have anything more to do with it. She then crushed well and ate the Eumolpid beetle, *Corynodes dejeani*, as also *Megalognatha rufiventris* and *Exosoma suturale* (all three had been some days in pill-boxes and were doubtless not up to their full strength), tasted and at once flung away a Coccinellid, No. 84, ate after much crushing and some hesitation a Phyt. beetle, No. 145, with yellowish exudation (these two were freshly captured), refused a Coccinellid like it (*Epilachna* 4-*oculata*, Kolbe), at last leaning forward to it, but withdrawing again without tasting, refused without tasting a *Mylabris oculata* (♂), tasted with hesitation and rejected a *Danaida chrysippus* with wings, did her level best to crush a large weevil, *Brachycerus congestus*, but failed utterly, as she did twice again on re-presentation. After this she refused to have any more to do with it, but comparatively easily crushed and ate a *Copris orion* ♂.

[*Order of preference* :—

(*a*) 1. *Corynodes dejeani*, *Megalognatha rufiventris*, and *Exosoma suturale* (all below full strength), and Phytophagon 145 (fresh and juicy).
    2. *Anachalcos spectabilis* (hard and rather glossy), Coccinellid 84.
(*b*) 1. *Copris orion* ♂.
    2. *Brachycerus congestus* (hard), *D. chrysippus*, *M. oculata* ♂, *Epilachna* 4-*oculata*, Coccinellid 84, and *Anachalcos spectabilis*.

The bird's great hunger must be kept in mind in assessing the probable value of the defences that caused refusal.]

Exp. 142.—*February* 2. Hungry. Offered a bright Buprestid, *Psiloptera cognata*, she accepted and tried to crush it, but the beetle at once slipped from her bill. This happened four or five times, and the bird thereafter refused to touch it again. She had made no impression on it. She then accepted a Chrysomelid beetle (*Horatopyga*), but it is distinctly hard and slipped from the point of her bill as soon as pressure was applied. On my reoffering it, it was seized more firmly, crushed well without appreciable difficulty, and swallowed in spite of its rather strong smell. The bird then tasted and at once rejected a *Lycus*, probably *constrictus*, readily accepted, crushed, and ate another *Horatopyga*, tasted and rejected (after a refusal without tasting in each case) a *Mylabris oculata*, a Coccinellid No. 84, and a *Zonocerus elegans* (adult ♀), and readily accepted another *Horatopyga*. It was again, however, seized with the extreme tip of the bill and it slipped away, and I was unable to find it to reoffer it. I then gave her a number of grasshoppers, after which she readily ate a *P. angolanus*, a *Teracolus*, and, to my surprise, a *Terias*.

[1. *Horatopyga* sp. (protected to some slight extent by hardness and gloss), bitter grasshopper, and perhaps *P. angolanus*, *Teracolus* sp., and *Terias*.

2. *Mylabris oculata*, Coccinellid (84), *Zonocerus elegans* ♀, *Lycus* prob. *constrictus*, *Psiloptera cognata* (hardness and gloss).]

Exp. 143.—Later in the day she readily ate a *Corynodes dejeani* (freshly captured), tasted and at once rejected a *Lycus*, probably *constrictus*, and refused persistently to taste a Coccinellid (84). I then placed a varied handful of Orthoptera, etc., in the cage, and the bird at once descended, ate a considerable number of them, and returned once more to her favourite perch apparently satisfied. She nevertheless readily ate ten more small grasshoppers which I picked out and offered by hand, refused, then tasted and rejected a *Terias*, but very readily ate a *Phrissura isokani* and a *Byblia*.

After five more grasshoppers she refused, then twice took in her bill and dropped an *E. hiarbas*, wings and all, being apparently very suspicious of it, or disinclined, but the third time definitely crushed it and swallowed it without further hesitation, refused *P. angolanus* without tasting, tasted well and swallowed a *Teracolus* (same sp. as other) with no sign of dislike, crushed well and swallowed the *P. angolanus*, accepted very readily and at once swallowed an *E. hiarbas*, refused, then doubtfully accepted, but ate a *B. severina*, took and rejected a *B. mesentina*, but on my reoffering it ate it, refused the next most persistently, as also a *Terias*, but readily accepted an *E. hiarbas*, refused for a few seconds, then took and dropped, but the third time definitely crushed and ate a *P. angolanus*, and after it readily nine small grasshoppers. Two more were eaten after a little coaxing, but the twelfth was finally and obstinately refused without tasting, as was also a *P. angolanus*. The roller then tasted and rejected a ♂ *P. demodocus*, refused without tasting a ♀ *H. misippus* with one hindwing attached, then twice took it from the forceps with an air of suspicion and each time slightly tasted and dropped it, refusing it after this without tasting, readily accepted and ate a *Precis clelia*, refused without tasting the ♀ *H. misippus*, and on my removing the sole remaining wing tasted suspiciously and rejected the body. Five minutes later she again tasted and rejected it, crushed very thoroughly and rejected, but on my reoffering it again crushed and this time ate a cricket (No. 8) that rather resembles a longicorn—she was evidently doubtful about it,—crushed and rejected a biting fly (*Rhinomyza denticornis*) after showing distinct hesitation in accepting it, dropped a Cetoniid, *Leucocelis ichthyurus* (it had been seized in the tip of the bill and slipped out accidentally), but obtained a better grip on my reoffering it and crushed and ate it readily, again crushed and rejected the fly and refused it on my reoffering it, lost a second Cetoniid in the same fashion (I was unable to find it to reoffer), twice crushed very carefully and thoroughly and each time ended by throwing away a beetle, *Himatismus fasciculosus*, crushed and very readily ate a *Libythea*, refused, then tasted slightly and rejected the wingless ♀ *H. misippus*, but readily accepted, crushed, and ate a ♂ *C. florella*.

Fifteen minutes later she twice crushed well and rejected the ♀ *H. misippus*, crushed thoroughly—it was rather hard—and ate with apparent relish a Lycoid wasp, crushed and ate the *P. demodocus* that she had previously rejected, tasted very slightly and threw away the *H. misippus*, refused for a long time and finally crushed and threw away a *P. angolanus*.

Five or ten minutes later some more butterflies came in. I offered a *P. lyæus* which was accepted and eaten, as was, readily, an *E. hiarbas*. The bird then for some time refused to have anything to do with a *P. angolanus*, but finally accepted it, crushed, held it for some time, evidently undecided whether to eat it, and finally swallowed it, but refused the *H. misippus* without tasting.

A little later I fed her on very small grasshoppers, etc., till she would eat no more. She then for a long time refused *P. angolanus*, but finally crushed it slightly and threw it away, tasted slightly and rejected, but on my reoffering it crushed very thoroughly and very doubtfully ate a *P. lyæus* after having twice made as though to throw it away, again obstinately refused to taste *P. angolanus*, crushed and rejected an *Atella phalantha*, refused for a long time a *Hypolimnas wahlbergi* with a forewing attached, evidently regarding it with the greatest suspicion, then just took it in the point of her bill and dropped it without crushing, refused without tasting the wingless ♀ *H. misippus*, refused for a considerable time *P. cebrene*, being evidently replete, but finally accepted and ate it, refused, then once more barely tasted and rejected *H. wahlbergi*, and treated *Atella phalantha* in the same way.

[*Lists*:—

(*a*) 1. Grasshoppers, *Phrissura isokani*, *E. hiarbas*, and probably *Corynodes dejeani*.
  2. *Lycus* nr. *constrictus*, Coccinellid (84).

(*b*) *Teracolus* sp. and *E. hiarbas* beside or just above *P. angolanus*, but latter placed more or less with *Belenois severina* and *mesentina*, though it may for the Pierines have been a matter of stimulation. *E. hiarbas*, grasshoppers, and *Precis clelia* above *Belenois severina* and *mesentina* and *Terias*.

(*c*) 1. *Leucocelis ichthyurus* } *Libythea laius*,
2. (On manner) Cricket 8. } *Catopsilia florella*.
3. *H. misippus* ♀ and *Rhinomyza denticornis*. (The *Libythea* and *C. florella* above *Himatismus fasciculosus* too.)

(*d*) 1. *Precis clelia*.
2. *Papilio demodocus*, on manner.
3. Lycoid wasp.
4. *H. misippus* ♀.

(*e*) 1. *Precis cebrene* and *Papilio lyæus* (*Precis clelia* above *Papilio angolanus*).
2. *P. angolanus*, *Atella phalantha*, *H. misippus* ♀, and grasshoppers.
E. hiarbas and *P. demodocus* probably not below *P. angolanus*.]

Exp. 144.—*February* 3. Showed distinct suspicion at the loud and continuous crepitation of a beetle, retreating along the perch when I brought it near. The sound was probably associated with something nauseous or otherwise unpleasant in the roller's memory.

Exp. 145.—*February* 7. Inserted, scattered amongst her other food, three or four of the brilliant red-and-black, softish, nut-flavoured seeds of *Trichilia chirindica*. They were ignored. The experiment, to test whether birds recognise food instinctively, was therefore inconclusive.

Exp. 146.—*February* 10. I fed the bird on grasshoppers till she would eat no more. She then took a *P. angolanus* without alacrity, crushed it for quite a long time as though she could not quite make up her mind to eat it, then suddenly turned it head inwards and swallowed it. She refused the next, then listlessly took and crushed it and tossed it aside, proceeding to treat a ♀ *P. lyæus* in the same way. I next presented a powerful wasp, *Salius basalis*, black with yellow legs and wing-tips, but the bird showed much suspicion of it as it buzzed and struggled in the forceps, and though she several times seized it she dared not hold it long in her bill, but each time quickly crushed and threw it down. On my killing the wasp by crushing the thorax she continued to treat it in the same way and finally refused it altogether. She had doubtless tasted it, but the result was conceivably (though doubtfully) even now prejudiced by her fear of the sting.

She then refused to touch *P. lyæus*, regarded with some suspicion, but on my continuing to offer tasted and then very readily ate a wingless *Precis artaxia*, readily accepted a wingless ♀ *H. misippus*, held in the forceps in such a way that only the black upper surface showed, but after crushing and tasting it with great thoroughness threw it away, readily ate another wingless *P. artaxia*, tasted very thoroughly and finally threw away a wingless *H. wahlbergi*, tasted rather hurriedly four or five times the *Salius*, and each time dropped it with an air of suspicion or disinclination, again tasted well and rejected the *H. misippus* ♀ and the *H. wahlbergi* and, more promptly, the *P. lyæus*, and accepted, tasted, and made a number of unsuccessful attempts to swallow a small dull-coloured mantis (*Ligaria* sp.). The creature, I found on looking closely, though inside the bill itself, had embraced the tip of the upper mandible with its claspers and was holding on tight. Finally, the bird flung it right away with an air of irritation. On my at once reoffering it, however, it was accepted very readily, crushed without a recurrence of the previous difficulty, and eaten.

[*Order* :—

1. *Precis artaxia* and *Ligaria.*
2. *H. misippus* ♀ and *H. wahlbergi* on manner above the Papilios.

Papilio lycæus, { 3. *Papilio angolanus.*
Salius basalis. { 4. Grasshoppers.

Interesting points were the probable force of the *Salius*'s sting (probably the wasp was otherwise unpleasant to some extent as well), the mantis's rather effective defence, and the *thorough* tasting of the two species of *Hypolimnas.*]

Exp. 147.—*February* 11. After a full feed of grasshoppers regarded a wingless body of *P. artaxia* with apparent suspicion and could not be induced to taste it.

Exp. 148.—*February* 12. Fed on grasshoppers till she would eat absolutely not one more, readily ate a *P. lycæus*, refused obstinately even to taste *P. angolanus*, tasted very thoroughly and threw away a ♂ *P. dardanus*, readily ate another *P. lycæus*, refused, then once more tasted and rejected *P. dardanus*, again refused to have anything to do with the *P. angolanus*, crushed well and rejected *P. lycæus*, but on my removing its one hindwing ate it fairly readily, as also three others without wings, the last two with a good deal of disinclination. She then leant forward to take a *Precis natalensis* ⊙ f. with all four wings (underside shown), but drew back before tasting it in evident suspicion and with shakes of the head. I removed all but half a hindwing and reoffered it with the upper surface showing (to avoid exhibiting the white spots on a black ground), at the same time holding the forceps over the remainder of the red ground-colour. The bird accepted it readily, but the red that was displayed by the removal of the forceps quite possibly rendered her suspicious, for she at once paused and appeared doubtful whether to go on, then hesitatingly dropped it. On my at once reoffering it she accepted it doubtfully, but this time definitely crushed it and, evidently reassured, swallowed it. She then ate a wingless *Charaxes cithæron* ♀, obstinately refused to touch a *P. lycæus*, also without wings, rather more readily accepted, tasted well, and then ate without hesitation a *Precis natalensis* with one hindwing attached, very readily accepted and ate the next, dropped the next, as also a *P. artaxia*, and refused even to taste *Antanartia schœneia* and *Catacroptera cloanthe* (underside shown). Evidently replete.

Five minutes later she accepted with disinclination, crushed slightly, and dropped *Precis clelia* and *A. schœneia*.

Three minutes later she readily ate *C. cloanthe*, refused without tasting *A. schœneia*, the hindwing of which had now come off, readily accepted and ate *P. natalensis* ⊙ f. and *P. artaxia*, refused without tasting *Atella phalantha* (with wings) and *Ant. schœneia*, readily ate a *P. tugela*, again refused the *Atella* and the *Antanartia*, but once more quite readily accepted and ate a *P. natalensis* ⊙ f.

[*Order* :—

1. *Precis natalensis* ⊙ f. and perhaps *Ch. cithæron*, *Precis artaxia*, *P. tugela*.

A. phalantha, *A. schœneia*.

2. *Papilio lyæus*.
3. *P. dardanus* ♂ perhaps on manner above
4. *P. angolanus*.

The initial attitude towards *P. natalensis* was very interesting, and suggests that even rarity—lack of practice—may be of use to a mimic under certain circumstances.]

Exp. 149.—*February* 13. Tasted and at once flung away a common blue frog-hopper, *Tettigoniella cosmopolita*, that settles conspicuously on the upper surface of large leaves and is fairly fearless; shook her head once or twice at a *Terias brigitta* with wings, but nevertheless accepted, crushed, and swallowed it, and accepted a brilliant metallic-green hymenopteron (*Chrysis* sp.). The wasp on being held by its wings in the forceps had adopted its usual plan of folding its head and thorax over into the hollow of its abdomen, and remained like this perfectly motionless while the bird endeavoured to crush it. She failed absolutely three times and each time ended by throwing the wasp away. The latter continued to lie motionless when rejected, and showed no sign of life even when I picked it up to reopen it. On the fourth occasion the roller succeeded in battering the wasp in two, but ended by rejecting it once more. That this rejection was due to the extreme toughness of the insect rather than to unpalatable qualities was shown by the fact that on my now reoffering one or other portion four or five times it was each time readily accepted and not rejected till the bird had made another attempt to batter or crush it. The covering of the abdomen was so intensely tough as well as hard that, when I squeezed it in from the sides, instead of breaking it would at once resume its former shape on the pressure being removed. The merest pressure on the sides of the separated abdomen served to extrude what looked like a sting, and in life the insect, though rolled up like an armadillo and in all other respects motionless, keeps darting this sting out (when held) now against the finger, now the thumb, in the most alarming manner.

After this incident I fed the bird up on grasshoppers till she would eat no more. She then refused, and on my coaxing her crushed and rejected a *P. angolanus* with one hindwing, and refused it without tasting on my removing this, crushed and tasted far more thoroughly and tried to swallow a *P. leonidas* with one forewing attached, but the wing kept getting in her way and she finally dropped the butterfly. On my reoffering it without the wing she ate it readily, but proceeded to do the same for a wingless *P. angolanus*.

[1. *Papilio leonidas* probably definitely better than *P. angolanus*.

P. angolanus.

2. Grasshoppers.
3. *Terias brigitta*, on manner, below grasshoppers.
4. *Tettigoniella cosmopolita*. *Chrysis* (failure).

The incident of the hymenopteron illustrated well the value of toughness to such an insect.]

Exp. 150.—*February* 14. Hungry. Ate an unusually large feed of grasshoppers, refused the last, but ate a *P. angolanus* with one wing, ate two or three more grasshoppers, refused the next, but ate another *P. angolanus*, ate a few more small grasshoppers and a *P. lycæus*, then a few more and this time not only finally refused to eat any more Orthoptera, but also persisted in refusing to taste a one-winged *P. lycæus*, even when I had removed the wing. She nevertheless readily accepted and ate a *P. natalensis* ⊙ f., persistently refused to taste a *Lachnoptera ayresi* with two wings, under surface shown, readily accepted and ate a *P. artaxia*, once more refused the *Lachnoptera*, but finally accepted, held it, tasted it well, though rather hesitatingly and with evident suspicion, and rejected it.

Five minutes later she once more obstinately refused it, ate a *P. cebrene*, and again refused to taste the *Lachnoptera*. I now cut off the remaining wings of the latter, all but a hindwing stump, and to this I applied the hindwing of a *P. cebrene*, holding it in place with the forceps while I reoffered the butterfly. The roller at once accepted it, but the *Precis* wing fell off as I withdrew the forceps, leaving the fulvous natural stump in full view. The bird certainly noticed it. She hesitated for a second or two, then carefully crushed the *Lachnoptera* and swallowed it, afterwards proceeding to taste and reject a wingless ♀ *P. lycæus* and readily ate a *Precis natalensis* ⊙ f. and two *Rhopalocampta forestan.*

Five minutes later she as readily ate a third *Rh. forestan* and a *Rhopalocampta libeon*. None of these skippers possessed any appreciable smell.

[*Order* :—

1. *Precis natalensis* ⊙ f., *P. artaxia*, probably *P. cebrene*, and perhaps *R. forestan* and *libeon*.
2. *Papilio lycæus*, *P. angolanus*, grasshoppers, and apparently *Lachnoptera ayresi*, so like *Atella* and probably taken for it, but its eating finally after a tasting perhaps less tinged with suspicion may indicate that it should go higher.]

Exp. 151.—*February* 20. Fed on grasshoppers, etc., rejected the last and refused obstinately even to taste any others. She then accepted and crushed a *P. lycæus* with one wing, held it for a considerable time and finally rejected it, refused it without the wing, refused for a time, then tasted with disinclination or suspicion and rejected a *P. natalensis* ⊙ f., then similarly took a *P. clelia*, crushed it carefully, and rejected it too. I was unable to decide whether this was the result of repletion or of suspicion.

Five minutes later she took the *P. natalensis* again with suspicion or disinclination, crushed and held it for a few seconds and threw it away, then treated the *P. clelia* similarly, but ended by eating this, refused obstinately to taste the *P. natalensis* again, readily accepted a *Rhop. forestan* with wings, crushed it well and rejected it, accepted it again on my removing the wings, crushed and held it for some time, and finally swallowed it.

Five minutes later again she persistently refused even to taste the *P. natalensis*, very readily accepted, crushed, and ate a *Catopsilia florella* with only one wing, equally readily accepted a *P. cebrene*, but on crushing she paused, and having tasted it yet further threw it away. Viewed with suspicion a wingless body of ♂ *C. florella*, and ended by taking it from the forceps and at once flinging it aside, readily accepted another ♂, this time with one wing attached, and held and crushed it for quite a time, finally however dropping it, refused, then tasted carefully and rejected a *P. cebrene* and obstinately refused to touch a wingless *P. lyœus*.

Five minutes later she ate the *P. cebrene*, refused without tasting the *P. natalensis* and a wingless *C. florella*, again crushed very thoroughly before finally rejecting it a *C. florella* with one wing, tasted and rejected *Antanartia schœneia*, *P. tugela*, and *P. cebrene*.

Five minutes later she accepted a Tenebrionid beetle, *Amiantus globulipennis*, exerted some slight pressure on the thorax and threw it away, evidently too replete to go to much trouble over it, crushed and rejected an Elaterid beetle, refused obstinately to taste a house-fly (*Musca domestica*), readily accepted, crushed, and swallowed a Cetoniid, refused without tasting a weevil (*Lixus* sp.) covered with bright yellow powder, refused, then just took from the forceps and threw aside a *P. natalensis*, looked suspiciously at a *P. tugela* and would not try it, then accepted and ate a *P. cebrene* and the *P. tugela* after the usual crushing, but with no sign of dislike, tasted and rejected *Antanartia schœneia* and a fresh *P. natalensis* (⊙ f., gravid ♀), also a wingless *C. florella*, of which she seemed to be suspicious, then refused without tasting a wingless *P. lyœus* and a *C. florella* with one hindwing.

Ten or fifteen minutes later she tasted and rejected *A. schœneia*, refused without tasting *P. natalensis*, readily ate *P. cebrene*, refused persistently to taste either *A. schœneia*, *P. natalensis*, or a *P. lyœus*, refused, then tasted suspiciously and threw away an *Iolaus silas*, tasted and rejected *L. thalassina* ♂, refused without tasting *C. florella* and *P. angolanus*, tasted and at once rejected a ♂ *P. dardanus*, crushed much more thoroughly, apparently almost persuaded to eat it, a *P. lyœus* but finally threw it away too, refused for a second, then, changing her mind, accepted, crushed, and ate the original *P. natalensis*, crushed very thoroughly once more and this time ended by swallowing *P. lyœus*, refused, then tasted, and at once rejected *P. dardanus* ♂, and refused obstinately to taste the ♂ *L. thalassina*.

Five minutes later she crushed well and finally rejected *L. thalassina* ♂, refused, then tasted and rejected *P. natalensis*, obstinately refused to touch either *P. angolanus* or *P. dardanus* ♂, tasted very carefully, evidently inclined to eat it, *P. natalensis*, but then rejected it, crushed and ate a *P. lyœus*, refused persistently without tasting *P. natalensis*, *P. dardanus*, and another ♂ *P. lyœus*, but readily ate after crushing it a *Salamis anacardii* with one hindwing attached, obstinately refused to taste the *P. natalensis* disguised carefully with a *P. cebrene* hindwing instead of its own, at once and readily accepted an actual *P. cebrene*, crushed and swallowed it (showing, I thought, that she had noted the difference in the colour of the bodies), refused to taste a *Scarabœus nigroœneus*, refused, then barely tasted and tossed aside a common house-fly (*M. domestica*).

Twenty minutes later I myself crushed the *Amiantus* well and reoffered it. The bird appeared not at all to like the look of it, and after a certain amount of hesitation tasted it and threw it away, whether out of disgust for its mangled condition or because she actually disliked or suspected it I am unable to say.

[*Order*:—

P. clelia & prob *R. forestan.*
1. *Precis cebrene, Salamis anacardii, C. florella*, probably Cetoniid.
2. *Papilio lyæus*

L. thalassina ♂, Grasshoppers.
3. *Precis natalensis*, ⊙ f.
4. *P. dardanus* ♂, *P. angolanus.*

probably not a great difference.

A. schœneia.
P. tugela.
A. globulipennis.
Elaterid, *Musca*
Lixus. [*domestica.*

I felt at the time that the rejection of *Precis clelia* in the first paragraph of this experiment required some special explanation, as it was unusual for the roller to eat grasshoppers to *junonia*-refusing point, and an inclination had been shown to eat *P. lyæus.* I thought suspicion rather than repletion might account for the rejection—suspicion perhaps that *P. natalensis* had been the cause of ill-effects on some previous occasion and rejection of *P. clelia* through similarity of taste. The incident of the *Lachnoptera* of the other day might have been even more productive of suspicion, and the roller's ready discrimination between *P. natalensis* with a *cebrene* wing and actual one-winged *P. cebrene* was interesting in this connection. Certainly the whole experiment—the special mistrust of the wingless white body of *C. florella* and so on—rather conveys the impression of a bird in a suspicious frame of mind.]

CORACIAS GARRULUS. A.

Exp. 152.—*February* 21. Accepted doubtfully, but then crushed and ate readily enough a smallish snail (probably a young *Achatina*), tasted and rejected a Lycoid sawfly (*Athalia himantopus*), its larva (destructive to turnips, etc.), and a bug (*Bagrada hilaris*), tasted and rejected a *Zonocerus elegans* and a *Mylabris oculata*, and accepted with suspicion but then readily enough ate a large yellow slug (on turnips). Ten minutes later I offered a second slug, which was eaten as readily.

[*Order*:—

1. The yellow slug.
2. The Lycoid sawfly, imago and larva, *Bagrada hilaris, Zonocerus elegans, Mylabris oculata.*]

Exp. 153.—*March* 1. Refused with shakes of the head, but on my pressing it on him tasted cautiously and refused to accept the larva of a Saturniid moth.

[Unfortunately nothing is stated as to the state of the roller's appetite.]

Exp. 154.—*March* 2. Very hungry. Attempted to eat a weevil, *Hipporrhinus chirindensis*, Mshl., but absolutely failed to crush it. After two or three attempts she refused to have anything more to do with it. Nevertheless, she crushed with comparative ease and swallowed a Tenebrionid (*Amiantus globulipennis*, Pér.). A dung-beetle, *Onthophagus panoplus*, was now seized, but was dropped with a shake of the head; from the position in which it had been taken I had no doubt that the upstanding central horn had made itself felt. On my reoffering it, the bird leant round and seized it more cautiously, definitely avoiding the horn, then crushed and ate it and after it a second. Even this, however, was once suddenly dropped, and on my reoffering it the abdomen was battered off and eaten, and the thorax dropped and refused on being reoffered. The first had given some difficulty in swallowing.

[*Order of ease*:—

1. *Amiantus globulipennis*, Pér. ("comparative ease").
2. *Onthophagus panoplus* (the horn, which however is confined to the males, was the first time of use in securing rejection).
3. *Hipporrhinus chirindensis*, Mshl. (complete failure to crush).]

Exp. 155.—*March* 2. Hungry. Leant forward to take a Psychid larva, but finding apparently on closer inspection that it did not look tempting withdrew with a shake of the head. She immediately changed her mind, however, and tasted the Psychid, but tossed it aside. I then fed her on grasshoppers, etc., till she would eat no more. She now refused to taste a Cetoniid, *Neptunides polychrous*, tasted well and rejected a Cetoniid (*Heterorrhina alternata*, Klug) crushed by the bulbul yesterday (it was only just alive), tasted and rejected a Cetoniid, *Spilophorus plagosus*, with elytra removed before presentation, took but threw aside after but a lazy and ineffectual pressure on it a Tenebrionid, *Amiantus globulipennis*, seemed disinclined to accept *Nyctipao macrops*, deterred probably by the huge wings. She took it, nevertheless, battered off the thorax and swallowed the abdomen with one wing attached. On my reoffering the thorax with the remaining three wings she took it again with disinclination, and after holding it tossed it aside.

[*Order*:—

1. *Nyctipao macrops*, but not necessarily more than *just* preferred to
2. *Amiantus globulipennis*, *Spilophorus plagosus*, *Heterorrhina alternata*, *Neptunides polychrous*, and definitely placed very low, whether on the merits of the larva itself or only on account of its casing, the Psychid larva.

Nyctipao macrops was only eaten partly and with evident disinclination. The large wings were probably a strong deterrent to a bird barely hungry enough for the moth.]

Exp. 156.—*March* 6. I offered a *Neptunides polychrous*, holding it by the legs, when it suddenly opened its wings and commenced a great buzzing. This obviously alarmed the roller, who, when she finally did make up her mind to try it, attacked it as she would a wasp, seizing it, hurriedly crushing it and throwing it down. This happened three or four times, after which I removed the elytra and reoffered it. It was still taken with suspicion, but finally *well* tasted twice in succession and each time definitely rejected. The bird then tasted and rejected a *Mylothris yulei* and refused to taste a *Terias*, but readily ate a large number of grasshoppers (chiefly *Tryxalis* sp.). She finally refused most obstinately to touch another, though I offered her at least eight comparatively pleasant species, readily ate an *Antanartia schœneia*, an *E. hiarbas*, and a large *Ch. candiope*, tasted and rejected *A. schœneia*, refused *Precis natalensis* ⊙ without tasting, but finally crushed it slightly and rejected it, ate after a momentary hesitation an *E. hiarbas* but would have nothing to do with the next, tasted and rejected a *Pap. demodocus* with wings and without, afterwards refusing it without tasting, and ate most readily after crushing it slightly a ♂ *Aterica galene*. She then persistently refused a *Lachnoptera ayresi* and a *P. natalensis* ⊙ f., but finally snatched each irritably from the forceps and gulped it down without an attempt at tasting it, and, after further refusals, an *Antanartia schœneia*. A *Pap. demodocus* was tasted more calmly and rejected, and a *Pr. tugela* crushed and readily eaten, but a *P. natalensis* ⊙ f. was taken and just tossed aside and, on being reoffered, was snatched away and swallowed with an air of extreme irritation as before; also a *P. ceryne* (a rubbed ⊙ specimen). *Pap. demodocus* was taken from the forceps and rejected, a *P. natalensis* eaten but the next rejected, and on re-presentation persistently refused. An *Atella phalantha* ♂ was similarly swallowed and the next rejected, but finally gulped down. A *P. natalensis* ⊙ f. was refused persistently, as was an *Atella* with wings, but the latter was finally accepted and swallowed and the *P. demodocus* once more taken and rejected. Another *Atella* was knocked out of the forceps, then for a time refused and finally snatched away and hurriedly gulped down. A *Phrissura isokani* was most obstinately refused without tasting, an *E. hiarbas* after being for some time ignored was snatched irritably from the forceps and swallowed, as was also a *Pr. natalensis* ⊙ f.; and the *Pap. demodocus* was again taken and thrown away. The bird was in a thoroughly irritable mood, but there was no mistaking the change when a *Ch. brutus* with one wing came on the scene. She took it with distinct eagerness and crushed and battered and swallowed it, obstinately refused to touch the *P. demodocus*, then ate a small grasshopper readily enough, but obstinately refused the next.

[The order would seem to have been roughly as follows:—

1. *Aterica galene*, *Charaxes brutus*, *Precis tugela*.
2. *Eurytela hiarbas*, *Antanartia schœneia*, *Atella phalantha*, *Precis natalensis* ⊙ f., and *Precis ceryne*.

Papilio demodocus.

3. The pleasanter grasshoppers and *Tryxalis* when many had been eaten in succession.
4. *Mylothris yulei*, *Terias*, and *Neptunides polychrous*.

Probably there is not much to choose between *Antanartia schœneia*, *Precis natalensis* ⊙ f., *Precis ceryne*, and *Atella phalantha*, none of which butterflies were at all acceptable in the actual state of the bird's appetite.]

Exp. 157.—*March* 13. Fed on grasshoppers till she would eat no more, tasted and rejected *P. demodocus*, but crushed and readily ate a *Lachnoptera ayresi* (♀) and a *Salamis cacta*, var. *languida*.

Fifteen minutes later she crushed well and rejected a Reduviid bug, *Harpactor erythrocnema*, readily ate a *P. demodocus*, threw away an *Amiantus globulipennis* after an irritable and not too strenuous pressure on its elytra, refused a hard weevil.

[*Order* :—

1. *Lachnoptera ayresi* (and *Salamis cacta*, if not merely a matter of special stimulation).

Amiantus globulipennis. { 2. *Papilio demodocus.*
3. *Harpactor erythrocnema.*]

Exp. 158.—*March* 14. *C. garrulus* battered a large, leathery, blackish slug with pale narrow dorsal stripe once or twice and threw it away. *Lanius collaris humeralis* tried to eat it, but was greatly bothered by the slime and rejected it finally without having injured it appreciably. The Bulbuls pecked at it, but getting their bills full of slime abandoned it. The Kingfisher (*Halcyon cyanoleucus*) banged it several times, and then rejected it. *Crateropus kirki* made a most prolonged attack, both shaking it about and hammering it with the point of its bill. It covered it with small scars, constantly desisting to clean its bill, but finally abandoned it altogether. All hungry, before food in morning.

[Evidently the slug was very low-grade, being protected efficiently both by its slime and its leatheriness.]

Exp. 159.—*March* 15. Crushed well and ate a *M. yulei*, battered very thoroughly and ate a *P. lycæus* larva, took with disinclination, crushed and rejected *M. yulei*, and twice refused, evidently regarding it with suspicion, but each time ended by accepting, crushing, and at once rejecting the larva of *Danaida chrysippus*, readily ate another larva of *P. lycæus*, and tasted with disinclination and rejected *M. yulei*.

[*Order* :—

1. Larva of *Papilio lycæus*.
2. Larva of *Danaida chrysippus* ; *Mylothris yulei* (imago).]

Exp. 160.—*March* 16. Readily ate an *A. phalantha*, a *Terias*, and a *M. yulei*, tasted and rejected an *A. esebria* with wings, and refused obstinately even to taste a wingless *Danaida chrysippus*, then tasted doubtfully and rejected an *Amauris lobengula*, underside shown, very faded and at a little distance even a possible model for *P. angolanus*, and utterly refused to have anything further to do either with it or with a rather rubbed *P. angolanus* similarly offered. On my reoffering both after a short interval she again refused to touch the *Amauris*, but readily accepted and ate the *P. angolanus*.

[*Order* :—

1. *Papilio angolanus.*
2. *Amauris lobengula.*

Hungry enough after an *Atella phalantha* for a *Terias* and after a *Terias* for a *Mylothris yulei*, but refused the rubbed *P. angolanus*, possibly in mistake for a very rubbed *Amauris* (to test which possibility the experiment was carried out), but possibly not, as she discriminated between them a little later.]

Exp. 161.—*March* 21. Rejected an *H. misippus* ♂, but then also tossed aside a *P. cebrene.* [Experiment therefore not worth continuing, time being short, and the roller not hungry enough. The rejection of the *Hypolimnas* not necessarily indicative of low grade.]

Exp. 162.—*March* 27. Refused, then tasted, and at once rejected a black gregarious Lepidopterous larva, ¾ inch long, tasted and rejected the young green larva of *Gonimbrasia* sp. (of Feb. 4), crushed very thoroughly and several times seemed inclined to swallow the half-grown (1½ inches) but already magnificently decorated larva of *Gynanisa ethra*, but in the end rejected it, refused absolutely to touch the black larva or that of *Gonimbrasia* on re-presentation, again readily enough accepted that of *Gynanisa ethra*, but after much battering ended by again rejecting it. On my reoffering it, three or four times, it was each time taken but after some slight crushing or battering dropped. I now produced a full-grown Lepidopterous larva (3½ in. × 0·7). The roller showed distinct fear or horror of it, drawing back and opening her bill and once or twice snapping at it viciously, and quickly withdrawing. Though I coaxed persistently I could not get her to touch it. She then tasted with disinclination and rejected a *B. mesentina* and a *Terias senegalensis*, ate readily a *P. angolanus*. A few minutes later she ate a *Bel. mesentina*, but threw a *T. senegalensis* right away and then refused to touch a second *Bel. mesentina* with such signs of dislike as seemed to indicate that the first had been eaten inadvertently or at any rate out of turn. She also again refused to touch the larva of *Gonimbrasia* (of Feb. 4), the black larva or the very large one, but readily ate a *P. angolanus* and a Passalid, *Eumelosomus zanzibaricus*, brown form, then leant forward and exerted a slight pressure on the elytra of an *Amiantus globulipennis*, and withdrew without attempting to take it from the forceps. But she ate with great relish, though with an occasional shake of the head—the result apparently of the strong pear-like smell,—a large bug, *Holopterna alata*.

[*Order* :—

1. *Holopterna alata*, *Papilio angolanus*, and (if its acceptance was not merely the result of the Papilio's) *Eumelosomus zanzibaricus*.

Amiantus globulipennis.
Terias sp.

2. *Gynanisa ethra*, half-grown larva.
3. *Gonimbrasia* sp., young green larva, also a black larva not yet identified.
4. Large larva, unidentified, regarded apparently with much dislike, as the result presumably of previous experience of itself or something like it.

Though two of the moth larvæ have not been identified, their placing is worth stating for the indication it affords of the varying degrees of inacceptability that exist amongst such larvæ.]

Exp. 163.—*March* 28. Tasted and rejected ant No. 31, but readily ate a *B. mesentina*, wings and all, *Later.* Hungry, tasted and rejected a large driver-ant (*Dorylus* sp.), and regarded with suspicion and rejected the larva of *Gonimbrasia*; the latter was barely tasted, simply taken and tossed away. She then refused to touch the black larva, refused, then tasted and rejected a *Mylabris oculata*, greedily ate a *B. mesentina*, several times took, crushed slightly, and threw away the large larva, tasted very thoroughly before rejecting it an *A. caldarena* both with wings and without, being evidently very nearly hungry enough to eat it, greedily ate a *M. yulei*, refused to taste a wingless *D. chrysippus*, again took the large larva (which had meantime been mauled by the shrike), tasted the wounded portion and rejected it, refusing to take it again, crushed and rejected the second ant (*Polyrhachis* sp.), refused to taste a *Zonocerus elegans*, then tasted and rejected a black fly (No. 19) and an earwig, also beetle (No. 154) common on turnips, but again eagerly ate a *B. mesentina*.

Later I fed her on grasshoppers till she positively refused to eat any more (she had eaten two or three abdomens after refusing the last complete grasshopper), crushed and rejected a wingless *H. misippus* ♀, readily ate a *P. angolanus* with wings, accepted doubtfully, crushed well and again rejected an *H. misippus* ♀ with all its wings, accepted doubtfully but having crushed it readily swallowed a *Teracolus eris* ♂, ⊙ f., with wings, tasted and rejected a *B. severina* with wings, but greedily ate a second *Teracolus eris* (⊙ ♂) also with wings, tasted with disinclination and rejected a *P. angolanus* both with wings and without, and twice a wingless *P. lyœus*.

Five minutes later she again accepted a ♀ *H. misippus* with wings, crushed it very thoroughly and carefully, and swallowed it wings and all, refused to taste a *P. angolanus* with wings or without, crushed and rejected the wingless *P. lyœus*, refused a second *H. misippus* with wings, but on my continuing to offer it crushed it slightly and threw it away, doing the same again when I had removed all wings but one, then refused to accept a *Pr. artaxia* or a *C. brutus*, each without wings, and on my continuing to hold them to it knocked each out of the forceps with the side of her bill. I reoffered the *Charaxes*, and she this time actually took it irritably in her bill, but finding it to be quite good crushed it well and swallowed it, and then crushed and swallowed the *P. artaxia* too. She then once more obstinately refused the *H. misippus* and finally knocked it out of the forceps, but readily—almost eagerly—accepted a *P. sesamus* ⊙ f. with all its wings, crushed it and swallowed it, then refused to taste a *C. florella* with one wing.

[*Order* :—

	(*a*)	(*b*)	
	1. *Bel. mesentina*, *Myl. yulei*.	1. *Charaxes brutus*, *Precis artaxia*.	*Precis sesamus* ⊙ f.
Danaida chrysippus, *Polyrhachis* sp. *Zonocerus elegans*. Fly 19, Ant 31, Beetle 154, Earwig.	2. *A. caldarena* (on manner), large larva.	2. *Pap. angolanus*, *Teracolus eris* ⊙ ♂.	
	3. *Dorylus*, *Gonimbrasia* larva, black larva.	3. Grasshoppers, *H. misippus*, *Bel. severina*.	*Pap. lyœus*.

The *Teracolus* was eaten up to the refusal-point of the two Papilios (or itself spoilt the bird's appetite for these). *H. misippus* was also then eaten to a point at which the Papilios were refused, then itself refused.]

Exp. 164.—*March* 29. Obstinately refused to touch a ♀ *M. agathina* with practically no scent, refused, then tasted and rejected a *Terias senegalensis*, crushed and readily ate a *B. mesentina*, wings and all, just closed her bill on an *Amiantus globulipennis* and withdrew without a real attempt to crush it, crushed well, breaking it up, and threw away a dull-coloured beetle, *Scaptobius pentarthrius*, and refused it with shakes of the head on my reoffering it (certainly unpleasant), refused to have anything to do with a common large Coprid larva, ate a few small grasshoppers and finally refused persistently to take any more, twice crushed and rejected a dragon-fly, tasted and rejected an *E. hiarbas* with wings and a *P. angolanus* and a *P. dardanus* ♂ with only one wing, crushed and rejected a second dragon-fly, ate with disinclination a wingless *P. demodocus*, tasted and rejected one of the dragon-flies without wings, ate a *P. angolanus* again with disinclination, and now tasted and rejected a *P. dardanus* ♂ as also another *P. angolanus*, each wingless, crushed slightly and dropped a large ♀ *E. neophron*, but on my reoffering it crushed it more thoroughly and ate it readily, tasted and rejected a Carabid, *Polyhirma bilunata*, Boh., and refused to touch a small Tipulid fly.

[*Order* :—

Belenois mesentina (not tried, however, against the last three insects in "4").	1. *Euphædra neophron.*	
	2. *Papilio demodocus* (with disinclination). 3. Grasshoppers.	*Papilio angolanus.*
	4. *Terias senegalensis, Mylothris agathina, Am. globulipennis, Scapt. pentarthrius*, Coprid larva.	*Papilio dardanus* ♂. Dragon-fly 10. *Eurytela hiarbas.*]

Exp. 165.—*March* 30. Hungry. With a few minutes' interval between each, crushed and rejected with dislike two separate hive-bees, readily ate a *B. mesentina*, refused, then tasted and threw away a *Terias senegalensis*, refused to touch another hive-bee (I had killed each bee before offering it), crushed and rejected two dragon flies, crushed and readily ate another *B. mesentina*, refused to touch a different wingless dragon-fly or a *Terias senegalensis*, tried an *Amiantus globulipennis* in her bill, but, finding it hard, threw it away.

A little later she crushed well and swallowed a beetle, *Himatismus fasciculosus*, refused, then accepted, crushed and swallowed a *T. senegalensis*, refused, then crushed and threw right away a hive-bee and obstinately refused to touch a dragon-fly. Later again she refused, then tasted and rejected a ♀ *M. agathina*, very readily ate a *T. senegalensis*, crushed well and again threw away the *Mylothris*, still with all its wings, tasted and at once rejected it with only one wing, accepted a ♂ *Neptunides polychrous* and tried to crush and batter it, but the beetle was tough and slippery and struggled violently, its sharp clinging claws frequently reaching the roller's lores and causing its hasty rejection. The bird each time readily accepted it again and had another try, but finally became irritated beyond measure and would have nothing more to do with it. The beetle was not greatly the worse for its experience. She then accepted an *Amiantus globulipennis* and tried for a few seconds to crush it by sheer bill-pressure, but, failing, threw it away, then crushed and readily ate two brown Phytophaga (*Horatopyga* sp.) each with its normal smell. The first of these I thought might have slipped down by accident without having been properly crushed, the second was well crushed. She finally crushed well and rejected a locust, *Taphronota calliparea*, that was exuding a quantity of froth. Butterflies in this experiment were offered wings and all.

[*Order* :—

Horatopyga sp. { 1. *Bel. mesentina.*
2. *Terias senegalensis.* } Hive-bee,
3. *Myl. agathina* ♀. } dragon-fly.
4. *Amiantus globulipennis* and *Neptunides polychrous*, each probably better defended (the former by hardness, the latter by claws, fighting weight, &c.) than *M. agathina* ♀ by nauseousness, *Taphronota calliparea* probably not better than *Horatopyga*, *Himatismus* not *necessarily* better than *Terias senegalensis*, and hive-bee and dragon-fly probably *not* better.]

Exp. 166.—*April* 8. Refused, then tasted, and rejected an *M. agathina* ♀, very readily ate after crushing it a *B. mesentina*, subjected to slight pressure and tossed aside a Tenebrionid beetle, *Psammodes mashunus*, Pér., refused to touch a grey isopod smelling of almond, an orange-coloured centipede (*Scolopendra morsitans*), a blister beetle, *Mylabris oculata*, or the *Mylothris* reoffered, very readily accepted and swallowed a *B. mesentina*, refused to touch a *Psammodes* sp., evidently regarding it with marked suspicion, pressed with her bill and threw aside a *Psammodes perfidus* and again *P. mashunus*, refused, then tasted slightly and rejected the grey isopod, definitely tasted and threw away the orange centipede, refused again to touch the *Mylabris oculata*, readily accepted and ate a *B. severina*, and once more refused *Mylothris agathina* ♀. The unidentified *Psammodes* had probably reminded it of an *Anthia*.

[*Order* :—

1. *Belenois mesentina* and *B. severina*.
2. *Mylothris agathina* ♀, *Mylabris oculata*, grey isopod (unbroken), *Scolopendra morsitans*, *Psammodes perfidus*.]

Exp. 167.—*April* 10. Readily accepted and ate a *B. mesentina*, refused, then accepted and ate with disinclination a *Terias brigitta*, readily accepted and ate another *B. mesentina*, tasted and threw away a frog-hopper, refused to touch an *Epilachna chrysomelina* or a *Mylabris oculata*, readily ate a *B. severina*, crushed and rejected a large grey isopod with almond smell, also an orange-coloured centipede (*Scolopendra morsitans*), readily ate another *B. severina*, tasted and rejected a Tipulid fly, refused to taste a frog-hopper and a *Psammodes* sp., then again crushed and rejected the Tipulid and a *Galerucella triloba*. Ten minutes later she tasted and rejected a Syrphid fly (*Rhingia cœrulescens*), but readily ate a large number of small grasshoppers. She now refused, then tasted slightly and rejected a *B. severina*, crushed well and rejected a *Diphrontis vethi*, refused without tasting a *Himatismus fasciculosus*, readily ate an *E. hiarbas* and a *Neptis swynnertoni* (both with wings), refused to accept a Locustid, *Enyaliopsis petersi*, after having very cautiously tasted the abdomen, and readily accepted and ate a *P. angolanus* with one wing. *Belenois* in nearly all experiments nowadays is offered with all its wings attached.

Later in the day I gave the roller grasshoppers till she accepted them with disinclination. She then crushed and readily ate a ♀ *H. misippus* with one wing, crushed well and rejected a *P. angolanus* with one wing and just took it, crushed it slightly, and threw it away on my reoffering it with the wing removed, barely tasted and tossed aside a *P. lyæus* with one wing, crushed and readily ate an *H. misippus* ♂ with one wing, crushed and rejected a *C. florella* and very readily accepted and ate a *P. natalensis* ⊙ f. She then tasted with disinclination and rejected a *P. dardanus* ♀ f. *hippocoon* and an ant-lion, a wingless *P. demodocus* and a *C. cloanthe* ♀.

[SUMMARY :—

(*a*) 1. *E. hiarbas* and *P. angolanus*.
2. *Himatismus fasciculosus*.

(*b*) 1. *P. angolanus*.
2. *Enyaliopsis petersi*.

(*c*) 1. *Diphrontis vethi*, grasshoppers, *E. hiarbas*, *P. angolanus*.
Tipulid and *Rhingia*. *Psammodes*. *Galerucella triloba*.
2. *B. mesentina* and *severina* (assuming them to be equal).
3. *T. brigitta*, frog-hopper, *Epilachna chrysomelina*, grey isopod, orange centipede.

(*d*) 1. *H. misippus* ♂ and ♀.
2. Grasshoppers, *P. angolanus* and *P. lyæus*.

(*e*) 1. *Precis. natalensis* ⊙ f.
2. *C. florella* (not better than *H. misippus*).

Papilio hippocoon, *P. demodocus*, *C. cloanthe*, and ant-lion not better than *Precis natalensis* ⊙ f.]

Exp. 168.—*April* 20. Very hungry. Twice, with a 5-minute interval between, crushed and rejected a large grey maggot-fly (*Sarcophaga* sp.), very readily accepted, crushed and ate *B. severina* with wings, again tasted and rejected a Tipulid fly and a *Mylabris oculata*, readily ate a gravid *M. agathina*, wings and all, tasted and rejected the fly and an *A. neobule* with one wing, refused to taste an *Epilachna hirta*. Fifteen minutes later she refused, then tasted and rejected, the fly and readily ate another *B. severina* with wings.

[*Probable order* :—

1. *Belenois severina* and *Mylothris agathina*, gravid ♀.
2. *Sarcophaga* sp., the Tipulid, and *Mylabris oculata*, also perhaps *A. neobule* and *Epilachna hirta*.]

Exp. 169.—*April* 25. Tried and rejected weevil 187, readily accepted and ate *Mylothris rueppelli*, tried and rejected a *Psammodes perfidus*, also some gnats, and refused a *Belenois*.

[*Order*:—

1. *Mylothris rueppelli*.
2. Weevil 187.

Nothing definite can be deduced with regard to the remaining insects.]

Exp. 170.—*April* 27. Hungry. Tried and rejected two weevils (No. 187 and 146), tasted and rejected No. 120, very readily ate *Belenois severina*, tasted and rejected a house-fly and a hive-bee, also *Mylabris oculata*, readily ate *Odynerus vulneratus*, tasted and rejected once more the house-fly and the hive-bee, and readily ate ♀ *Mylothris agathina*, wings and all.

[The *order* (allowing for the known relative position between the *Belenois* and *Mylothris*) was: firstly, *Belenois severina*, *Mylothris agathina* ♀, and *Odynerus vulneratus*; and, secondly, weevils 187 and 146, 120, house-fly, hive-bee, and *Mylabris oculata*.]

Exp. 171.—*September* 20. Found eating grasshoppers hungrily. Tasted and rejected a stalk-eyed fly (*Diopsis*), readily ate *Henotesia perspicua*, refused the fly, crushed and readily ate *Byblia ilithyia*, refused the fly, eagerly ate *P. angolanus*, again refused the fly, but ate with avidity 12 medium-sized grasshoppers and another *P. angolanus*. I had nothing of a lower-grade nature to offer.

[*Henotesia perspicua*, *Byblia ilithyia*, *Papilio angolanus*, and grasshoppers were distinctly preferred to the *Diopsis*, and the number of grasshoppers and butterflies eaten after its first refusal were considerable (16), showing appetite.]

Exp. 172.—*September* 29. Hungry. Inspected and refused to touch *Musca domestica*, readily accepted and ate a *Terias brigitta*, tasted well and rejected a large bluebottle (*Calliphora*), again readily ate a *T. brigitta*, tasted and rejected a *Musca domestica*, and refused without tasting a bluebottle, afterwards tasting well and rejecting a fruit-fly. After a number of grasshoppers she tasted and at once flung away an *A. rahira*, readily ate a *P. angolanus* and a *N. agatha*, and refused to touch the *A. rahira* (all of them wings and all).

[The pleasanter grasshoppers, *Papilio angolanus* and *Neptis agatha* were preferred to the fruit-fly, and the latter (on manner) to *Musca domestica* and *Calliphora*. *A. rahira* was placed below *P. angolanus* and *N. agatha*.]

Exp. 173.—*November* 23. Refused, then tried and rejected, *Chrysops wellmanni*, and readily ate in preference to it a small dull grasshopper and *P. angolanus*, refused, then tried and rejected, *M. agathina* ♀.

Exp. 174.—*December* 2. Tried and rejected *Aletis monteironis*, ate readily in preference to it a Tenebrionid beetle, *Micrantereus vicarius*, and, more slowly, a cockroach, *Gynopeltis cryptospila*, tried and rejected emphatically a grasshopper (*Euprepocnemis* sp.).

Exp. 175.—*December* 4. Tried and rejected a grasshopper, but ate readily, crushing it easily, an isopod, a smallish individual.

Exp. 176.—*December* 5. (After grasshoppers.) Refused without tasting, then tried and rejected a grasshopper (*Catantops* sp.) and *Aletis monteironis*, ate readily *Mycalesis campina*, tried and rejected *Terias senegalensis*, tried and rejected a big *Acridium lineatum*, and battered very thoroughly a huge horny Longicorn, *Mallodon downesi*, but failed repeatedly to swallow it, the head and thorax being the difficulty. She finally battered these off and swallowed the rest, tried and rejected the head and thorax reoffered. Later she threw away a large Coprid larva, but ate readily that of a Cetoniid beetle, *Rhabdotis aulica*.

[*Order* :—

1. Larva of *Rhabdotis aulica*.
2. *Mallodon downesi* (thorax and head the difficulty).
3. *Acridium lineatum* (interesting that evidently regarded as less easy than the big Longicorn), *Terias senegalensis*, *Aletis monteironis*, and *Catantops*.

The *Mallodon* had been found moving sluggishly about in the forest.]

Exp. 177.—*Later*. Hungry, just before noon. Tried and rejected a grasshopper (*Catantops*), a moth (*Syntomis cerbera*), and a grasshopper (*Atractomorpha*), but readily tackled a very frothy *Taphronota calliparea*, banging it for several minutes and several times commencing to swallow it before finally throwing it away. She then readily ate an Asilid fly, *Alcimus rubiginosus*, three grasshoppers, three larvæ of *Rhabdotis aulica*, another Asilid, and a *Mycalesis campina*, a large grasshopper (*Xiphocera*), then yet another Asilid and a *P. angolanus*.

[*Alcimus rubiginosus* was preferred to *Taphronota calliparea*, and the latter certainly tempted the roller more than *Syntomis cerbera* and the two grasshoppers. It is even probable that *M. campina*, *P. angolanus*, and the large grasshopper (*Xiphocera*) were also preferred to *Taphronota*, but the complicating factor of possible special stimulation is unfortunately present.]

Exp. 178.—*December* 6. After a few grasshoppers. Ate readily a beetle, *Anomala ustulatipes*, and a bug, *Echinocoris* sp., but also a *Terias senegalensis*, failed to crush and abandoned a weevil, *Brachycerus congestus*, refused without tasting a house-fly (*M. domestica*), then took and swallowed it, tried and rejected *Acræa caldarena*.

[Probably very hungry to have eaten the house-fly (which she has already placed lower than *Terias*), and this gives a partial measure of the difficulty presented by *Brachycerus congestus*.]

Exp. 179.—*December* 10. Tried and rejected large green fly (*Pycnosoma*), an Anthomyiid fly, large brown fly, house-fly and another fly (*Anthomyia*), and refused persistently without tasting *Zonocerus elegans*, ate readily in preference to all these *Terias senegalensis* and a black Cetoniid (*Diplognatha gagates*).

Exp. 180.—*December* 11. Refused without tasting a housefly and the following flies :—*Morellia prolectata*, *Anthomyia* sp., *Pycnosoma* sp., and an Anthomyiid, ate readily *Alcimus rubiginosus*, tried and rejected a hive-bee twice, tried and rejected *Mylabris oculata*, again persistently refused without tasting all the above flies, seized a large Carabid, *Tefflus hacquardi*, but at once threw it away and remained gasping on her perch for a couple of minutes, then ate readily a grasshopper (*Catantops*), tried and rejected and then persistently refused without tasting a hive-bee, refused persistently without tasting all the above flies, tried and rejected *Zonocerus elegans*.

Later, refused emphatically without tasting, then tried and rejected a fly (*Pycnosoma chloropyga*), persistently refused without tasting a house-fly, refused without tasting, then tried very thoroughly and finally rejected, a Syrphid fly, doubtful. She then persistently refused without tasting a hive-bee, ate readily an Asilid, *Microstylum validum*, refused without tasting, then tried and rejected, the Syrphid, refused emphatically, then barely tried and rejected without tasting another fly, ate readily *Alcimus rubiginosus*, readily ate nearly 40 grasshoppers mostly small, refused to touch any more, ate readily *Alcimus rubiginosus*, refused quite decidedly without tasting it the Syrphid.

[In the first experiment *Alcimus rubiginosus* was preferred to the various other Diptera used, as was grasshopper 47, and the latter was also preferred to *Mylabris oculata*, *Tefflus hacquardi*, and hive-bee, against which three insects the *Alcimus* was not pitted.

In the second experiment *A. rubiginosus* was preferred to house-fly, *Pycnosoma chloropyga*, the Syrphid (itself probably preferred to the other two), and to hive-bee, and *M. validum* was preferred to all but one fly, against which it was not pitted. The fact that nearly 40 grasshoppers were eaten after the last of the rejections shows how low the insects involved must be placed.]

Exp. 181.—*December* 15. Hungry. Ate readily a moth, several grasshoppers, another moth, tried well and rejected an Ortalid fly (*Peltacanthina stictica*), ate readily a third moth, refused emphatically and persistently without tasting it a housefly, tried and rejected a *Hæmatopota* near *brunnescens*, ate readily a *Terias regularis* captured on the Gambadziya and a moth, and tried and rejected a blister beetle, *Mylabris oculata*. She then ate several grasshoppers—all to-day have been eaten with disinclination—and refused any more, ate readily one of each of the three Lycænids, a *Mycalesis campina*, and a *Terias senegalensis*, but then went back to grasshoppers.

Later, having been fed on grasshoppers till she refused more, ate readily *Phrissura isokani*, tried and rejected *Alæna nyassa*, and then three Lycænids, also the moth and *Hæmatopota* near *brunnescens*, and refused without tasting a fly (*Peltacanthina stictica*) and a housefly, tried and rejected a *Teracolus* and a *Terias*, ate *very* readily a *Pap. angolanus*, and once more refused the rest without tasting.

[*Order* :—

1. *P. angolanus*.

Alæna nyassa.
2. Moth, the three Lycænids, *Terias regularis* (and probably *T. sengalensis*, *Myc. campina*), grasshoppers.
3. *Hæmatopota* nr. *brunnescens*, housefly, *Peltacanthina*, *Mylabris oculata*.

Phrissura isokani was eaten in preference to grasshoppers, but not tested against the rest, though it is probably not lower than the *Alæna*, refused just after its acceptance.]

Exp. 182.—*December* 27. Readily ate *Belenois mesentina* and three grasshoppers, then tried and rejected scented Longicorn (*Closteromerus viridis*), ate readily *B. mesentina*, twice failed with a Buprestid, *Psiloptera cognata*, it glancing out of her bill each time.

[*Closteromerus* and the *Psiloptera* (in virtue of hardness and gloss) below *B. mesentina*.]

Exp. 183.—*January* 8, 1911. Fairly hungry, crushed without any great difficulty and ate a dung beetle, *Catharsius rhinoceros* ♀. The thorax with elytra attached fell away during crushing.

Crushed and ate a round forest "woodlouse" isopod.

Exp. 184.—*January* 10. Fairly hungry. Refused decidedly without tasting a blister beetle, *Lytta thoracica*, then took a Locustid, *Enyaliopsis petersi*, by the thorny thorax exuding juice, pressed it, and threw it away, refusing to have any more to do with it.

Exp. 185.—*January* 12. Fear of owl. A barn-owl (*S. flammea*), dead, but with eyes open and held in a life-like position, was shown to the birds to-day. Roller indifferent.

Exp. 186.—*January* 13. Fairly hungry. Pressed a dung beetle, *Gymnopleurus fastiditus*, and as it did not yield threw it away. The same with a second. But a *Micrantereus vicarius* crushed more easily and was swallowed. She then tried and rejected, failing to crush it, a large weevil (*Brachycerus*), but accepted an *Enyaliopsis petersi*, which she battered into a pulp and swallowed. She kept closing her eyes or drawing the nictitating membrane across as she did so, but I think that it was only when one of the locust's tarsi approached an eye, and not in consequence of the latter's unpleasant qualities.

[*Enyaliopsis petersi* and *Micrantereus vicarius* less well protected relatively to the roller than *Gymnopleurus fastiditus* and the *Brachycerus*.]

Exp. 187.—*January* 14. Alarmed at a large live Amphisbænid, but only very moderately so. [To test knowledge of harmlessness.]

Exp. 188.—*February* 1. Tried and rejected an *Amauris albimaculata*. Refused without tasting *Acræa johnstoni*.

[A mimicry experiment.]

Exp. 189.—*February* 27. *Very* hungry, readily ate an *A. johnstoni* and an *A. igola*, refused without tasting *A. caldarena.*

Exp. 190.—*March* 1. Kept longer than usual without food and very hungry, readily ate after crushing it an *A. igola*, red ♀, tried and rejected *A. caldarena* and a second *A. igola* (♂), readily ate, after crushing it, an *A. johnstoni*, and refused, then tasted slightly, and rejected the *A. igola* ♂ reoffered.

After a full-grown larva of *Rhabdotis aulica* she refused most emphatically and persistently without tasting it *A. esebria* (a slightly buffy-white ♀), *Nyctemera leuconoë*, *A. lobengula*, and *A. albimaculata.*

A little later (she had fed well meantime) she refused a *P. lyæus* and a grasshopper 1061, then refused, tasted slightly and rejected first a *Pitthea continua*, then a *Papilio echerioides* ♂, and thereafter refused to touch them again, refusing with equal persistence to taste an *Antanartia schœneia*, an *E. hiarbas*, and a *Charaxes natalensis.* All were offered with their upper surface fully displayed. On my offering them with the *under* surface up, the moth was still refused but the *Antanartia* readily accepted, though thrown away after thorough tasting. The *P. echerioides* ♂ and the *E. hiarbas* were persistently refused, but the *C. brutus* accepted, eagerly crushed, and swallowed.

[SUMMARY:—*A. johnstoni* was preferred to *A. igola* ♂ and to *A. caldarena*, and the latter at any rate not liked appreciably better than *A. igola.* At this point of considerable hunger very little feeding produced a refusal of *A. esebria* ♀, *N. leuconoë*, *A. lobengula*, and *A. albimaculata*, all of which might, therefore, be presumed to be low-grade. *C. brutus natalensis* was preferred to *A. schœneia*, *E. hiarbas*, *P. echerioides* ♂, *P. lyæus*, *Pitthea continua*, and grasshopper 1061. A good mimicry experiment, the bird distinguishing by their under surface butterflies resembling each other on the upper surface.]

Exp. 191.—*March* 2. I fed the roller on meat (the lights of a freshly killed sheep) till he would eat no more; he persistently refused the last piece with shakes of the head; then offered a *Terias senegalensis* and a *M. yulei*, both of which were accepted and eaten, though an *A. johnstoni* was refused. She then refused to touch an *A. dominicanus*, or, after it, a black and white ♀ *A. esebria*, cautiously tasted an *A. neobule* and rejected it, thereafter refusing persistently to touch either it, a bright ♂ *M. igola*, or a ♀ *A. doubledayi* with a slightly clear-wing appearance, refused to taste either a *Nychitona medusa* or a *Redoa melanocraspis*, both, as also the preceding offerings, offered with wings spread and upper surface shown. Ate two grasshoppers, then persistently refused to touch a *M. rueppelli* or a *Mylothris*-mimic, but accepted hesitatingly, then readily ate, a *Phrissura isokani* ♂.

[*T. senegalensis* and *M. yulei* were preferred to the meat, and, at any rate, probably not liked *less* than *A. johnstoni*, *A. dominicanus*, *A. esebria* ♀, *A. neobule*, *A. igola* ♂, *A. doubledayi* ♂, *L. medusa*, and *Redoa melanocraspis.* ♂ *Phrissura isokani* was preferred to *M. rueppelli*, and was tried, though hesitatingly, where a more definite mimic was refused. It was perhaps of interest that *A. neobule*, the first of its colour to be offered, was tried, while the second, *A. doubledayi* ♂, with a clear-wing appearance, was refused.]

Exp. 192.—*March* 3. Had fed not long before. Refused to touch meat or a *Terias brigitta*, then tasted slightly and refused the latter. Tasted and rejected an *A. phalantha*, and refused to touch it again, refused persistently to taste a *Lachnoptera ayresi*, offered similarly with upper surface displayed, and refused both butterflies offered to show the under surface only, again refused the *Terias*, accepted and crushed a *Mycalesis campina*, but then threw it away, readily ate a *P. angolanus*, tasted and rejected a second *Atella phalantha*, without wings, accepted hesitatingly, but, having tasted it, readily enough ate a *Lachnoptera ayresi*, also wingless, and again tried and rejected the wingless *Atella*. She next crushed and flung away a *Cyclopides metis* and refused thereafter to touch either it, a *Padraona zeno*, or a *Kedestes chaca*, all offered with the upper surface displayed. On my reoffering them with only the *under* surface shown, she refused the *C. metis*, tasted rather hesitatingly and ate the *K. chaca*, tasted, though with hesitation, the *Cyclopides* and once more flung it away, accepted, crushed and readily ate the *P. zeno*, ate a *Leuceronia thalassina* ♂, hesitated over an *E. hiarbas* but decided not to take it, accepted, pressed with her bill, and threw away a *Dielis 5-fasciata* (the rejection was due, I thought, at least partly to its hardness), refused to touch again either it or two other wasps. Tasted and rejected a yellow-legged wasp (*Salius* sp.) and readily ate a small grasshopper.

[SUMMARY :—

(*a*) 1. *L. ayresi*, *P. angolanus*.
2. *A. phalantha*, *T. brigitta*, *M. campina*, meat.

(*b*) 1. *K. chaca* and *P. zeno*; perhaps *L. thalassina* ♂.
2. *E. hiarbas* and *C. metis*.

(*c*) 1. Small grasshopper.
2. *Dielis 5-fasciata* and *Salius*, the other two wasps being quite likely refused through likeness to the *Dielis*.

A good mimicry experiment, three homœochromatic groups being successfully tested.]

Exp. 193.—In the late afternoon, hungry, she refused, then tasted slightly, and again refused an *A. areca* ♀, and after it refused a large ♀ black and chestnut *A. esebria*, which, had it been spotted, would have been by no means unlike the *A. areca*; both had their upper surface fully displayed. On my now showing the under surface the *A. areca* was again refused, but the *A. esebria* tasted before rejection.

A little later I offered the *A. esebria* with upper surface displayed. It was this time tasted and rejected, and thereafter both it and an *A. cabira* (much like it, except for size) were persistently refused without tasting. A *Terias senegalensis* was eaten.

After a few grasshoppers the roller tasted and rejected, then refused, a *Terias regularis* and persistently refused a *Teracolus auxo*, a *Terias senegalensis*, and a *T. brigitta*, but ate a *Mycalesis campina*.

[Another experiment, illustrating well how a bird may be deceived or rendered suspicious by a likeness, while ready to test any new pattern. It is probable that the *A. cabira* escaped trial through its resemblance to the *A. esebria* which had been tried and rejected, and the *Teracolus*, *Terias senegalensis*, and *T. brigitta* mainly through their likeness to *T. regularis*. *T. senegalensis* was preferred to the Acræas tasted and *M. campina* to *Terias regularis*, and each seemed to indicate the bird's state of appetite when influenced by the resemblances.]

Exp. 194.—*March* 4. Twice seized the head and thorax of a huge Elaterid beetle (*Tetralobus* sp.) from in front, and each time the beetle "clicked" itself clean out of her bill. She then refused for a time to touch it again, but finally made a flank attack, seizing it across at the joint of the thorax and abdomen, and commenced to bang its head against the perch, but, after the first blow, the beetle, which had probably slipped back in its bill, released itself as before.

Exp. 195.—*March* 4. Very hungry indeed, accepted an *A. lobengula* and crushed it well, and would, I believe, have swallowed it had it not stuck across her bill. This gave more time for hesitation and she ended by throwing it away, afterwards refusing to touch either it, *Pap. echerioides* ♀, *A. johnstoni*, or *A. esebria* (buff hindwing like this group), though doubtful over the latter, but she at once accepted, crushed, and ate *Amauris albimaculata*. After a small grasshopper she refused to again touch *A. albimaculata*, *A. lobengula*, *A. johnstoni*, *P. echerioides* ♀, and the *A. esebria*, but readily enough accepted and ate an *A. igola*. Of all the above the upper surface only was shown. The bird next tasted unhesitatingly and rejected, underside uppermost, a dull white (and black) *A. esebria*, and refused it and a white-marked *A. johnstoni* without tasting, as also a buff-patched *A. esebria* and a buff-patched *A. johnstoni*.

Later she tasted and rejected *Planema aganice* and refused both it and a large black and white ♀ *A. esebria*, both with upper surface shown, and went on once more to refuse the whole of the previous two series and the *P. aganice* (underside). She then ate several grasshoppers, a *Mycalesis campina*, and a few more grasshoppers, took with disinclination but threw away the next *M. campina*, then refused it, refused too *M. safitza* and a dull ♀ *Crenis boisduvali*, readily ate an *E. hiarbas*. These were all offered with upper surface shown. On my reoffering them with only the under surface showing the bird persistently refused to touch the *M. campina*, tasted rather hesitatingly and rejected the *M. safitza*, and readily took and ate the *Crenis*, then tasted and rejected the yellow-legged *Salius*.

[A mimicry experiment that is worth a little study with the insects before one. Thus while the two species of *Mycalesis* and the *Crenis* are sufficiently alike on their upper surface to render it intelligible that the bird might refuse the other two after rejecting one, their under surfaces are unlike in the degrees actually indicated by the bird's treatment of them when thus offered. The preferences shown were *A. igola* to *Amauris albimaculata*; *E. hiarbas* and *C. boisduvali* to *M. campina* and *M. safitza*.]

Exp. 196.—*March* 5. Very hungry. Refused persistently to touch either a large Elaterid (*Tetralobus* sp.), probably remembering its previous acrobatic feats, or a larva of the large Saturniid, *Gynanisa ethra* (pale green with silver spikes, only about one-fifth grown), or an *A. caldarena*, refused, then hesitatingly tasted and threw away a *Planema aganice*, refused it, a large white-and-black ♀ *A. esebria*, and a *Pap. echerioides* ♀, all showing the *underside* only, accepted with reluctance, then tasted well and threw away a small Saturniid larva of the same species (perhaps one-fifth grown), eagerly ate a *Belenois severina* and, from the state of her hunger there evinced, would, I felt sure, have taken even a *Mylothris* had I had one to offer.

[*Order* :—

1. *B. severina.*
2. Larva of *Gynanisa ethra*, *P. aganicè* ♀, *A. caldarena*, *Tetralobus* sp.

A further mimicry experiment, this time to test such resemblance as exists between the undersides of *Pl. aganice*, *A. esebria*, and *Pap. echerioides* ♀.]

Exp. 197.—*March* 21. Very hungry indeed. Accepted an *A. lobengula* and crushed it very thoroughly before rejecting it, almost disposed to eat it, a second time accepted and rejected it, then refused to touch it again and equally persistently refused a ♀ *Aterica galene* (upperside in each case), but ate (an indication of some hunger) a very large spiky-legged *Acridium* (*A. lineatum*), and showed the greatest eagerness for a *Charaxes brutus* I was carrying to a bulbul.

[A very striking suggestion of the probable value to *A. galene* of its resemblance to *A. lobengula.*]

Exp. 198.—*March* 23. Very hungry. Persistently and with shakes of the head refused to touch a *P. echerioides* ♀ with upper surface displayed, also refused to taste a *P. dardanus* ♀ f. *trophonius* either with wings open or closed, or a *Danaida chrysippus* offered in both positions. On my now reoffering the *P. trophonius* she showed a distinct inclination to try it, but decided not to, refused positively an *A. encedon* and a *Mimacræa marshalli*, and once more became interested in the *Papilio trophonius*, upper surface, but ended by again refusing it; refused positively to touch an *A. albimaculata* with light hind-wing patch, leant forward to take an *A. johnstoni* (which she should now be getting to know well), but thought better of it and withdrew—both these were offered with upper surface shown,—but at once seized it when offered with *closed* wings, crushed and swallowed it.

Refused to touch *A. caldarena* ♂, refused, then tasted and rejected red ♀ *A. igola*, but accepted and ate a *Callioratis bellatrix* and another *A. johnstoni* (underside), refused most emphatically and persistently without tasting *P. echerioides* ♀, upperside, but at once seized, crushed, and readily ate a ♂ with closed wings. She then refused persistently to have anything to do with three Indian butterflies, *Parantica aglæa*, Cram., ♀, *Papilio chaon*, Westw., and *Papilio memnon agenor*, Linn., each with an appropriate local body—actually those of *P. echerioides* ♂ and *P. lyæus* respectively,—but eagerly ate an actual *P. lyæus*.

[An interesting mimicry experiment, the absolute refusal of *P. trophonius* before the bird was visually reminded of the *Danaida*'s exact appearance, and his inclination to take it afterwards being highly suggestive. That it still was not taken seems a testimony to the deterrent value of even an imperfect likeness, and that no inclination to take *A. encedon* or *M. marshalli* was displayed illustrates the view that a still more perfect likeness may be still more effective. The treatment of *A. johnstoni* and *P. echerioides* ♀ respectively was equally interesting, and the bird was shown to be hungry enough for either.

The three Indian butterflies were offered to test previous knowledge, as *C. garrulus* visits India in its migrations. However, the result, though a refusal, can hardly be regarded as in any way conclusive.

Preferences:—1. *A. johnstoni*, *P. echerioides*, *Callioratis bellatrix*, and *Pap. lyæus*.
2. *A. albimaculata*, *D. chrysippus*, *A. caldarena* ♂, and red ♀ *A. igola*.]

Coracias garrulus. B.

Exp. 199.—*April* 2. Refused to touch a *Diestogyna iris* ♀ or a *D. chrysippus*, but at once tried to seize on a *D. chrysippus* f. *alcippus*. I withdrew it and once more offered the other two, which were as persistently refused as before. I then reoffered the *alcippus*, and this time allowed the roller to seize it, which she did readily; but on crushing it she threw it away, refused, then crushed and rejected an *A. johnstoni*, readily ate a *Terias brigitta*, and reached out readily enough for an *M. yulei*. It was old and dry, and was accordingly at once rejected. I had merely offered it to see whether it would be refused without tasting.

Half an hour later, no food meantime, she tasted and rejected the Indian Danaine, *Parantica aglœa*, with a lively *D. chrysippus* body, refused then to touch either it or a *Nepheronia ceylanica*, showed some inclination to try *Hestia nama* but refrained, refused to touch *Tirumala septentrionis*, tried *Chittira fumata* with a *Danaida* body and rejected it, again refused persistently to have anything to do with the *Tirumala*, but hesitatingly once more tried the *Parantica* and again rejected it. I now gave a small feed of grasshoppers, then offered a *Terpsichrois mulciber*, which I had accidentally omitted before. It was refused without tasting.

In this experiment the roller went back on his refusal of *Parantica* the other day and showed a much more marked suspicion of *Tirumala*.

[The special testing invited by an unaccustomed colour-variation was illustrated at the commencement of the experiment, a form of *D. chrysippus* being thus specially tried when even a rather poor mimic of the commoner form was avoided. The Indian butterflies also gave rise to quite a good colour-experiment and the refusal of the *Terpsichrois*, unlike the others in coloration, struck me as conceivably due to previous experience.

T. brigitta and *M. yulei*, both well known to the bird, were preferred to *D. chrysippus* and *A. johnstoni* and, with the latter, fixed exactly her state of appetite. She was probably even hungrier after the interval, though less so when it struck me to offer the *Terpsichrois*.]

Exp. 200.—*April* 7. Hungry—early morning. I placed several coffee-bugs (*Antestia lineaticollis*) in cage. The roller descended, tried one or two and rejected them, then returned to her perch. From the forceps she refused one, then tasted and rejected it with disgust, refused an *Epilachna hirta*, refused, then in turn tried and threw away, an *Amauris albimaculata*, an *Acræa caldarena*, and an *A. igola* ♂, but readily accepted, crushed, and ate an *Mylothris rueppelli*. [*M. rueppelli* preferred to each of the other insects.]

Exp. 201.—*April* 18. Very hungry. Tried and rejected a larva of *A. albimaculata*, refused, then tried and rejected *A. caldarena* and *A. esebria* ♀, accepted, crushed, and ate a *Rhodogastria bubo* (foam exhausted) and an *M. yulei*, tried with her bill and refused to take a large weevil (*Brachycerus apterus*) and a *Psammodes mashunus*, and refused to even taste a *Psammodes* sp. or a *Psammodes perfidus*, again refused *A. caldarena*, but took another *Rhodogastria*, and crushed it well before throwing it away.

I then gave her a feed of grasshoppers, after which she refused, then tried and rejected, a hive-bee, and refused to taste again either it, a *Podalirius vestitus*, or two flies mimicking Hymenoptera, ate a few more grasshoppers, tried and rejected a bee (*Xylocopa*), and refused to touch again either it or large flies with the same colouring, refused persistently with shakes of the head to taste a Lycoid Lygæid bug, accepted a Lycoid *Nupserha*, and crushed it very thoroughly before throwing it away—evidently it was not very highly disliked,—then refused to touch a *Myc. campina* or a *Papilio angolanus*, but readily ate a *Charaxes brutus natalensis*, wings and all.

[*Preferences* :—

	1. Grasshoppers and *Charaxes brutus*.
M. campina, *P. angolanus*.	2. Lycoid *Nupserha*.
Hive-bee. *Pod. vestitus*. *Xylocopa*.	3. *Rhodogastria bubo*. 4. *A. caldarena*, ♀ *A. esebria*, and (through hardness) *Psammodes mashunus*, *P. perfidus*, *Psammodes* sp., and *Brachycerus*.

Also a mimicry experiment, Dipteron mimics of Hymenoptera being tested and two members of the Lycoid group. The Lycoid Lygæid, though not actually tasted in this experiment, is actually very low grade indeed, and the *Nupserha*, whose Lycoid coloration failed to save it from tasting, was shown to be, if anything, probably more acceptable than *M. campina* and *P. angolanus*.]

Exp. 202.—*April* 18 (continued). Later in the day (had had a feed meantime) refused, then barely crushed and dropped, a *Belenois mesentina*, readily ate a *Myc. campina* and a small piece of meat, refused to touch a second small piece of meat or a second *M. campina*, but readily ate after crushing each a *Glutophrissa saba* (*ochlea*-like), a *P. isokani* ♂, and a *Teracolus achine* ♀, refused to touch *M. campina*, but readily accepted and ate *Neptis agatha* and *Byblia goetzius*.

[*Order* :—

1. *N. agatha* and perhaps *B. goetzius*, *G. saba*, and perhaps *P. isokani* ♂ and *Teracolus achine* ♀.
2. *M. campina* and possibly the meat.
3. *B. mesentina*.]

Exp. 203.—*April* 24. Had had a good feed not long before, but had since brought up a large and a small pellet. Refused, then tried and rejected, *Brachycerus apterus*, then ate no less than six *Acridium lineatum*—an unusual feat, for the larger specimens are usually found somewhat unmanageable, but these were all fairly small, running roughly three to the ounce. She then ate a large number, weighing in all two-thirds of an ounce, of small grasshoppers of various species, finally refusing to take any more. But she accepted and, after running it through her bill with a somewhat uncertain air, finally swallowed without the smallest sign of dislike the contents, extracted in one piece, of the abdomen of the large *Brachycerus* she had previously rejected. She then refused with shakes of the head to touch *P. angolanus*, refused a *P. lyæus*, but, as I continued to offer it, finally accepted, crushed it, and played with it for some seconds, tossing it into the air and catching it again, then threw it away and refused to touch it again. She then refused to touch a small grey larval mantis, a light brown Locustid, a Tsamon-tree Locustid or a mantis. The first two and the last of these she had to my knowledge had before now in her food. She similarly refused a *Precis elgiva*, a *Rhop. pisistratus*, and an *Antanartia schœneia*, but accepted, crushed, and held a *Rhop. libeon*. She appeared too replete to swallow it and could not be induced to do so, though she each time made some show of activity, even by means of a fluttering *Charaxes vologeses* held in front of her bill. I left her, and returning five minutes later found her still holding *R. libeon*, which, however, she now relinquished in favour of the *C. vologeses*. She failed with this too, as also with a *Charaxes ethalion* ♂ and a *C. brutus*, relinquishing each in turn after crushing it and holding it for several minutes in her bill. No sign of dislike was shown for any of them, nor of regret for having eaten the *Brachycerus* contents. At the same time she had filled up unusually quickly after refusing grasshoppers.

[*Order* :—

1. Contents of *Brachycerus apterus*, probably about on a level with *R. libeon*, *C. vologeses*, *C. brutus*, and *C. ethalion*.

Probably *R. pisistratus*, *P. elgiva*, *A. schœneia*, the two Mantises, the two Locustids, *P. angolanus* and *P. lyæus*.

2. *Acridium lineatum* and grasshoppers generally.
3. Uncrushed *B. apterus*.]

Exp. 204.—*April* 27. Refused without tasting, then tried and rejected, *Mylothris rueppelli*, readily accepted and ate a *Belenois mesentina* and several large grasshoppers, crushed and rejected a *B. mesentina*, readily ate a *Byblia ilithyia*, took two more grasshoppers, refused to accept a *Byblia goetzius* or the *B. mesentina*, but crushed and at once swallowed the Lycænid that mimics *Nyctemera* (the first ever captured at Chirinda itself). But, pushing down her crop-contents by means of an elongation of the neck followed by a visible contraction (this had happened as I offered the Lycænid too), she went on to eat not only the *B. goetzius* but the *B. mesentina*, though she refused, then crushed slightly and rejected, a *Terias senegalensis*.

Later. I had just placed in her cage a feed after a hungry spell, when it struck me to offer the pupa of *A. albimaculata.* She had already eaten the first grasshoppers, and she attacked and crushed well, then threw away, the pupa. As she at once continued her feed, it was useless to offer anything for comparison with the pupa, but it was evidently fairly strongly disliked.

[*Order* :—

Grasshoppers. 1. *Nyctemera*-like Lycænid.
2. *B. ilithyia.*
3. *B. mesentina* (*T. senegalensis* not better than it).
4. *M. rueppelli.*

Amauris albimaculata pupa was probably placed *low.*]

Exp. 205.—*April* 30. Refused to touch or taste a driver-ant, *Dorylus* sp., with shakes of the head, but accepted, crushed, and ate an *A. terpsichore.*

Exp. 206.—*May* 2. Should have been very hungry before morning meal, which was in any case late. Refused, then barely tasted and threw away, an *Epilachna hirta,* refused, but quickly tasted slightly and rejected, a turnip sawfly larva (*Athalia* sp.), ate fairly readily five coffee-bugs (*Antestia lineaticollis*), refused, and on my continuing to hold it to her tried and rejected, *A. albimaculata,* refused *A. neobule* and *A. serena,* refused, then barely tasted and rejected, *A. serena,* tried and rejected *A. cabira,* but ate with hesitation another coffee-bug.

Considerably later, no food meantime, she refused another coffee-bug, and after it once more refused to touch a *Mylabris, Epilachna hirta,* the sawfly larva, *Amauris albimaculata, Acræa neobule, A. natalica, A. buxtoni, A. cabira,* again the coffee-bug, and a *M. rueppelli,* but very readily accepted and ate a *Belenois mesentina.*

[*Order* :—

1. *B. mesentina.*

Mylabris, 2. *Antestia lineaticollis.*
M. rueppelli, 3. The other earlier insects used.]
A. natalica.

Exp. 207.—*May* 3. Crushed well and swallowed a swollen cattle-tick (*Rhipicephalus* sp.), tasted and rejected a black recurved ant (*Polyrhachis gagates*), a grey ant, an unswollen tick, a driver-ant (*Dorylus*), several fruit-flies (*Ceratitis*) held together in the points of the forceps, but evidently regarded two or three black aphides (of orange) as too insignificant to deserve attention, most persistently refused without tasting *Amauris albimaculata,* crushed slightly and rejected in turn *Acræa serena, M. agathina* ♀, and a *T. senegalensis,* but readily accepted and ate *B. mesentina,* again tried and rejected fruit-flies (*Ceratitis*), ate a fly of the species used for the "drivers" the other day, but looked exceedingly doubtful after it and shook her head. She refused to accept a second, but after some persuasion on my part tried it and threw it away, then readily ate a full-fed cattle-tick, and after a great deal of battering an *Enyaliopsis petersi.*

[*B. mesentina,* a full-fed cattle-tick, and probably *Enyaliopsis petersi* preferred to any of the others, including *T. senegalensis* and unfed cattle-tick of same species. The eating of fly was probably a mistake.]

Exp. 208.—*May* 3. Later, hungry before a meal, refused persistently to accept a *P. dardanus* ♀ f. *cenea*, upperside exposed.

[Doubtless a result of its excellent likeness to *Amauris lobengula.*]

Exp. 209.—*May* 23. Refused with a shake of the head a coffee-moth larva and continued to refuse it. This was not long after a feed, though not a very large one. The bird would quite likely have eaten a *Neptis* had it been offered.

Exp. 210.—*May* 24. Hungry before a meal. Readily accepted and ate two coffee-berry-moth larvæ, accepted, probably inadvertently, and at once threw away in great disgust an *A. lobengula*, refused to touch a white-banded ♀ *Acræa doubledayi* or an *A. esebria* ♂, but finally on my pressing it on her tasted and threw the last away, refused to touch an *Mylothris yulei*, readily accepted, crushed, and ate a ♀ *M. agathina*, and after it ate the *M. yulei* too, refused the *A. esebria*, but finally on my pressing it on her again tried and rejected it, readily ate a coffee-moth larva and a number of grasshoppers, etc. She then once more ate a coffee-moth larva, refused obstinately to touch *B. mesentina*, *T. senegalensis*, *Myc. campina*, *N. agatha*, or *B. ilithyia*, but readily accepted, crushed, and ate a *Leuc. thalassina* ♂ and with disinclination a coffee-moth larva. After a few more grasshoppers she repeated all her previous refusals, but readily ate an *Eurytela dryope*, crushed and flung away a *Myc. campina*, and, though accepting it with disinclination, at once swallowed after crushing it another coffee-moth larva. I had not the material wherewith to conclude the experiment, but it was already evident that the larva was not greatly disliked. This was perhaps to be expected in the case of an insect that spends a great deal of its time hidden away in or amongst berries.

[*Order*:—

(*a*) 1. ♀ *M. agathina*, coffee-moth larva, grasshoppers.
2. *M. yulei*, ♀ *A. doubledayi*, ♂ *A. esebria*, and *A. lobengula*.

(*b*) 1. *L. thalassina* ♂, *E. dryope*, grasshoppers, moth-larva probably not higher.
2. *B. mesentina*, *T. senegalensis*, *M. campina*, *N. agatha*, and *B. ilithyia.*]

Exp. 211.—*June* 4. An experiment by lamplight. Accepted and ate three pieces of meat, threw away the rest, and refused obstinately to accept any more (freshly dead leg of lamb), readily accepted and ate a *Bel. mesentina*, crushed and rejected a *Terias brigitta*, crushed very thoroughly and ended by rejecting a *Xylocopa africana*, merely took in the tip of her bill, crushed slightly, and dropped another *Xylocopa* and *X. senior* ♂, and readily ate another *Bel. mesentina*.

Shortly afterwards she crushed and rejected *Xylocopa senior* ♂, refused both it and the other two, and readily ate a *Bel. mesentina*.

These refusals and acceptance she repeated twice again with intervals between.

Next time she ate a *B. mesentina*, crushed and rejected *Xylocopa* sp., and refused both it and the other two species, then readily ate both a *Bel. mesentina* and the *Terias senegalensis*.

A little later again she crushed very thoroughly indeed and ended by swallowing a *Xylocopa africana*, refused a second, also ♂ *Xylocopa senior* and the third species, a *Mylothris yulei*, and a piece of meat, accepted a *Terias brigitta*, but, after a great deal of crushing and an evident inclination to eat it, rejected it and very readily accepted, crushed slightly, and swallowed a *Belenois mesentina*, afterwards once more refusing the bees.

[*Order* :—

1. *B. mesentina.*
2. Perhaps, on manner, *Terias brigitta* and *senegalensis* and *Xylocopa africana.*
3. The other Xylocopas, *M. yulei*, and lamb.]

Exp. 212.—*June* 5. Hungry, just before morning meal, readily ate a ♂ *Acræa serena*, crushed and rejected in turn an *A. asema* and an *A. caldarena*, readily ate a ♀ *A. serena* and two pieces of meat, crushed slightly and rejected *Xylocopa africana*, refused to touch either it or *Xylocopa* sp. and *X. senior* ♂, crushed and rejected a ♂ *A. serena*, and readily ate a *Mylothris yulei.*

I kept reoffering the three bees at intervals, ♂ *X. senior* usually first. Sometimes they were refused without tasting, sometimes merely taken in the point of the bill, crushed slightly, and dropped ; none eaten or even accorded anything like a serious crushing.

On the last occasion the roller crushed slightly and rejected an *A. serena* and, in turn, the three bees, refused these, again crushed slightly and rejected the *A. serena*, but accepted, crushed, and readily ate a ♂ *M. agathina* and a piece of meat.

[*Order* :—

1. ♂ *M. agathina* and, perhaps, lamb.

Xylocopa { 2. *A. terpsichore.*
spp. 3. { 3. *A. caldarena* and *A. asema.*]

Exp. 213.—*June* 6.—Refused to touch *A. caldarena*, crushed slightly and dropped *A. serena*, refused, then accepted, crushed slightly, and rejected two moth-larvæ eaten by the natives, refused to accept an *A. esebria*, an *A. serena*, or a *Mylothris yulei*, but very eagerly seized on, crushed, and swallowed a *Belenois mesentina*, evidently much preferred to any of the others.

Exp. 214.—*June* 7. Probably quite hungry ; before early morning feed. Readily accepted, crushed, and swallowed four Termites (two small soldiers and two small workers).

[Returning in the evening, after an absence, I found that the hornbills had pulled out several trays and that the roller and *P. layardi* B had in consequence escaped, while the kingfisher had found his way into the roller's cage. A careful search, continued throughout the next morning, failed to discover the roller ; her wings were in excellent condition and she had possibly flown away. But the bulbul returned on the 8th with a request for re-admission.]

Experiments on *Coracias garrulus*. C.

Exp. 215.—*March* 7, 1911. A just-captured roller (*C. garrulus*) was brought to me this morning. By the afternoon he was already so much at ease as to readily accept insects from the forceps. I gave him a *Rhabdotis* larva and a number of grasshoppers, after which he refused to touch an *A. caldarena*, a *D. chrysippus*, an *A. esebria* or an *M. rueppelli*, but readily accepted and ate a *Padraona zeno*, refused a *Terias senegalensis*, a *Lyc. lemnos*, a *Myc. campina*, and a *Crenis boisduvali*, these last two offered with upper surface displayed, but accepted readily and ate a *Leuceronia thalassina* ♂, refused a ♂ *Lycus* sp., again refused the *Mylothris* and the *Terias*, also a *Precis natalensis* ⊙ f., readily took, crushed, and ate an *A. schœneia* and after it to my surprise swallowed down the *Myc. campina*, but seemed annoyed and refused to touch another or the *Crenis* re-offered, even with the underside up, refused a second *Leuceronia thalassina* and again the *Lycus*, accepted a little doubtfully but on crushing it readily ate an *Andronymus neander*, refused a *P. demodocus* and a *P. lyœus*, and on my persisting in offering them took each from the forceps and without tasting them dropped them on the ground, but readily ate a *Cyligramma latona*, then took and dropped a *Rhabdotis* larva and a small grasshopper, tried and rejected *Charaxes candiope* and *Sphingomorpha chlorea*. The *Charaxes* and the *S. chlorea* were each simply snatched from the forceps, crushed and dropped and a grasshopper was similarly treated; but, judging from the preceding portion of the experiment, the bird must in any case have been nearly replete.

[*Order* :—

A. schœneia.	1. *C. latona* and *A. neander*. 2. *L. thalassina* ♂.
Lycus sp. ♂, *C. boisduvali*, *Precis natalensis* ⊙ f. (or whatever it was taken for).	3. *A. caldarena*, *A. esebria*, *D. chrysippus*, *M. rueppelli*, *T. senegalensis*, *Lycœnesthes lemnos*, *M. campina* (and, if not taken for *M. campina*, *C. boisduvali*).

C. latona also over *P. demodocus* and *P. lyœus* and quite as high as the grasshopper, *C. candiope*, *S. chlorea*, and the *Rhabdotis* larva.

P. zeno over at any rate the first four species in Grade 3 above.

But the *great* point of the experiment was that a bird captured that very day and without previous experience of them in captivity should have given proof of its experiences in the wild state by refusing to touch a Danaine, two species of *Acrœa*, a *Mylothris*, a *Terias*, a *Lycœnesthes*, a *Mycalesis*, and a *Lycus*, and, when nearly replete, a *P. demodocus* and a *P. lyœus*—all of them more or less disliked by my long-captive roller,—while readily accepting and eating species that my long-captive roller would also under those conditions of appetite have readily eaten. The refusal of the *Precis natalensis* was probably due to its *Acrœa*-like appearance, and the first refusal of the *Crenis* seemed due, possibly, to its likeness to *M. campina*, but its subsequent refusal when the underside also was shown may have indicated that, if known, it was itself then unacceptable.]

Exp. 216.—*March* 8. After a few grasshoppers, would have nothing to do with an *A. caldarena* or a *Terias brigitta*, and on my persisting in offering them snatched each from the forceps and without attempting to taste or crush it dashed it on the ground. But he at once accepted and ate a *Sph. chlorea.* The next four offerings were four days old and dry, but were offered to test his previous knowledge of insects of their respective colour-patterns. He refused to touch a *Redoa melanocraspis*, at once accepted a *Neptis goochi*, but after crushing it threw it away, presumably because dry, persistently refused without tasting a "*Terias Teracolus*," but readily enough accepted a *Myc. campina*, and treated it as he had done the *Neptis*. He then refused to touch an *Aulacophora vinula*, tasted and dropped a grasshopper No. 47, then picked it up again, crushed it and threw it away, ate a grasshopper 1051, at once accepted but, on crushing it, threw away a *Mylabris oculata*, readily accepted and ate a *P. demodocus*, an *L. thalassina* ♂ and a *C. brutus*, refused persistently to touch a *Lyc. lemnos*, but readily accepted and ate a ♀ *Crenis boisduvali* offered underside uppermost. He now refused to accept grasshopper 47, readily ate grasshopper 1061, refused 47, tried and rejected 1051, readily ate the common grasshopper with red wings and black and white marks under thorax, readily ate No. 86, refused 1051, readily accepted and ate 1061 and 19, then barely tasted and emphatically refused 19, 1061, and the white-chequered one, refused emphatically and persistently without trial *A. albimaculata* (outspread upper surface) and *D. chrysippus* (underside), but greedily accepted and swallowed the very large moth, *Nyctipao macrops*, and showed the greatest eagerness for a *Ch. brutus*, which, however, I required for another experiment and withdrew. But I shortly afterwards offered him a *Ch. candiope*, which he at once swallowed, as usual, wings and all.

It surprised me in the above experiment that the roller was apparently less sure of his beetles and grasshoppers than of his butterflies.

One-and-a-half hours later, no food meantime, tried and rejected a house-fly (*M. domestica*) and a hive-bee, tried and rejected a ♂ grasshopper 1051, dropped, then ate a ♀ and readily accepted and ate a smallish *Acridium lineatum*. No hesitation had been shown in tasting the house-fly and very little, if any, over the hive-bee. It had now clouded over heavily, and it is possible that if he knew the insects' placings well already it was too dark in the verandah to allow of certain recognition.

[*Order* :—

A.

1. *N. goochi*, *M. campina*, probably *S. chlorea.*
2. *A. caldarena*, *T. brigitta* and *Redoa melanocraspis.*

The *Teracolus* was probably taken for a *Terias*.

B.

C. brutus,
C. boisduvali,
P. demodocus,
L. thalassina ♂.
A. lineatum, grasshopper 86.
1. *Nyct. macrops* & probably *C. brutus* & *C. candiope.*
2. Grasshoppers 1061, White-chequer, and 19.

A. albimaculata 3. ,, 1051.
D. chrysippus. 4. ,, 47, *Aulacophora vinula*, *M. oculata*, *L. lemnos*, *Musca domestica*, and hive-bee.

Again numerous low-grade Lepidoptera (and one low-grade beetle) were refused without tasting, an indication of previous experience in the wild state. They were *D. chrysippus*, *A. albimaculata*, *A. caldarena*, *T. brigitta*, the *Terias*-like *Teracolus*, *L. lemnos*, *R. melanocraspis*, and *Aulacophora vinula*, and the refusal of the *Teracolus* was a probable indication of the value of mimicy relatively even to a just-captured bird.

Exp. 217.—*March* 9. Refused emphatically and persistently *A. caldarena*, a dull ♀ with outspread wings, and *Terias senegalensis*, tried and rejected a *Deudorix*, refused emphatically without tasting *A. albimaculata*, but readily accepted and ate *E. hiarbas*, most persistently refused without tasting a blue-black beetle-larva (*Catamerus*), a Lycoid moth, and again the *Terias*, crushed and readily ate *B. mesentina*, persistently refused without tasting the *Terias* and a *D. chrysippus*, showed some slight inclination to accept a ♀ *Hypolimnas misippus* (no bar) but did not do so, persistently refused without tasting *Azanus moriqua* and *Castalius calice*, inspected closely and ate *Catochrysops dolorosa*, persistently refused without tasting *Castalius sybaris*, inspected and readily accepted and ate *Atella phalantha*, refused without tasting then tried and rejected a rather dry *Phycœnura*, both surfaces shown, tried and rejected the *Deudorix*-like *Lycœnesthes*, readily accepted and ate *Antanartia schœneia* and a yellow ♀ *Catopsilia florella*, most persistently refused without tasting the *Terias*, *A. lobengula*, and a small Lycid (*Brachycerus*), ate an *Ypthima*, most persistently refused without tasting a large weevil, but at last pressed slightly and desisted, refused similarly without tasting an Ichneumon, refused without tasting and then with disinclination tried and rejected *B. mesentina* and *Atella*, persistently refused without tasting *Terias*, readily accepted and ate *N. agatha*, *Ypthima impura*, *Eurytela hiarbas*, and a *Hœmatopota* (?), refused without tasting then tried and rejected a house-fly, readily accepted and ate *E. hiarbas*, refused without tasting then tried and rejected a very large *Tryxalis*, decidedly refused without tasting *Tryxalis turrita*, but readily ate a grasshopper 19, most persistently refused without tasting the *Belenois* and the *Atella* and once more the large *Tryxalis*, readily accepted and ate various grasshoppers including *Catantops sulphureus* and now, after at first refusing it, a *T. turrita*, persistently refused without tasting it the large *Tryxalis*, but readily accepted and ate grasshopper No. 1053.

In the afternoon, hungry, he *most* persistently refused without tasting a *Terias*, but readily accepted and ate a *B. mesentina* and an *A. phalantha*.

[*Order*:—

C. dolorosa, *Ypthima*, *A. schœneia*, & probably yellow *C. florella*.	1. *N. agatha*, *E. hiarbas*, grasshoppers 19 and 1053, and perhaps *Ypthima* sp., *Hœmatopota* sp., and *Catantops sulphureus*. 2. *A. phalantha* and *B. mesentina*.
Lycœnesthes sp., *Azanus moriqua*, *Castalius calice* and *sybaris*, *D. chrysippus*, *Physcœnura*, *A. lobengula*, small Lycid, large *Brachycerus* and Ichneumon.	3. *T. senegalensis*, *Lycœnesthes* sp., *A. albimaculata*, dull ♀ *A. caldarena*, blue-black Tenebrionid larva, and, if known on its own merits, which is unlikely, the Lycoid moth.

Additionally, *Ypthima* was placed above the *Lycænesthes*, *A. moriqua*, *C. calice* and *sybaris*, *Physcænura*, *D. chrysippus*, *A. lobengula*, and the small Lycid; *A. schœneia* and perhaps yellow *C. florella* above these except possibly the first two; *C. dolorosa* and *A. phalantha* above at any rate *A. moriqua*, *C. calice* and *sybaris*, and *D. chrysippus*; *E. hiarbas* above *Musca domestica*; and grasshopper 19, grasshopper 1053, and probably *Catantops sulphureus* above *M. domestica*, *Tryxalis* sp., and *T. turrita*.

N.B. (1) Inclination to try unbarred *H. misippus* (*inaria*).

(2) Close inspection before acceptance of *C. dolorosa* at a time when certain other small Lycænids were unacceptable, including a *Lycænesthes* with an underside not unlike *C. dolorosa*'s in general effect.

(3) The further refusals without tasting, indicating probable previous acquaintance, of dull ♀ *A. caldarena*, *A. albimaculata*, *A. lobengula*, *D. chrysippus*, *A. moriqua*, *Castalius calice* and *sybaris*, *T. senegalensis*, the blue-black Tenebrionid larva, the too-hard *Brachycerus*, the Ichneumon, *Tryxalis turrita*, and *Tryxalis* sp., and two members (model and mimic) of the Lycoid group—namely, *Lycus* sp. and a Lycoid moth.]

Exp. 218.—*March* 20. Refused emphatically and persistently an *A. lobengula*, took without enthusiasm, crushed and threw away a *Terias brigitta*, ate a *Belenois severina*, most persistently refused without tasting *M. agathina*, *A. neobule*, *A. esebria* (♂), *A. johnstoni*, and *A. lobengula*, readily accepted and ate *Henotesia perspicua*, picked up and ate some grasshoppers lying in cage, *most* persistently refused without tasting *P. echerioides* ♂ with underside shown, but at once accepted it reoffered with upperside uppermost, crushed it well and threw it away, refusing to touch it again. I then offered a *C. brutus*, with upperside similarly displayed and it was refused, but, on my showing the underside, at once accepted, crushed, and swallowed.

The bird appeared to be suffering some discomfort after swallowing the *Charaxes.* He has diarrhœa to-day and is evidently not very well. He then most persistently refused without tasting *Papilio echerioides*, upperside, *E. hiarbas*, *Byblia goetzius*, and *A. phalantha*, accepted an *A. schœneia*, but dropped it after crushing it, refused without tasting, then took with disinclination and dropped a *P. lyæus*, *most* persistently refused without tasting *P. hippocoon*, upper surface, accepted it with under surface up and forewings well back behind the hindwings, crushed and swallowed it, then brought it up again and rejected it, again very positively refused without tasting *A. phalantha*, *E. hiarbas* (underside), *P. hippocoon* and the *Byblia*, accepted and dropped a *P. elgiva*, picked it up again, crushed and dropped it, persistently refused without tasting *P. demodocus*, accepted a *C. candiope*, showing some eagerness as it was approached to him, but could not bring himself to eat it either.

Later in the day most persistently refused without tasting *Amauris albimaculata*, *A. johnstoni*, *A. esebria*, *A. igola* ♂ and black-and-white ♀, *A. caldarena*, *P. aganice* ♂, *M. rueppelli*, *Pinacopteryx isokani* ♂, *T. brigitta* and *B. severina*, all offered with closed wings; readily accepted and ate *E. hiarbas*, *most* persistently refused without tasting *B. severina*, *A. phalantha*, *P. hippocoon* with spread wings, *B. goetzius*, *P. natalensis* ⊕ f., *Teracolus* sp. (upperside shown), *Lachnocnema bibulus*, *T. brigitta*, *P. isokani* ♂, and *M. rueppelli*, readily accepted and ate

Neptis agatha, again persistently refused without tasting all the above, but readily accepted and ate *Neptis swynnertoni*, again persistently refused without tasting all, descended and ate three or four grasshoppers, most persistently refused without tasting *E. hiarbas*, ate an *A. schœneia*, most persistently refused without tasting *P. dardanus* ♂ and *P. demodocus*, refused but then tried and rejected *P. hippocoon* (underside), persistently refused without tasting *P. echerioides* ♂ (upperside), refused without tasting, then crushed and dropped *P. angolanus*, refused without tasting, then took and dropped *P. demodocus*, and after the usual persuasion took and this time ate a *P. lycæus*, again persistently refused without tasting the rest, also *A. schœneia*, both white and yellow *C. florella*, *Platylesches picanini*, and *Padr. zeno*, but accepted a *C. candiope*, afterwards refusing a *P. elgiva*. Again ruffled and sick-looking.

[SUMMARY :—

1st experiment :—

A.

1. *H. perspicua*, *C. brutus*, grasshoppers, *B. severina* above *T. brigitta*, but not tested against *A. neobule*, &c.
2. *T. brigitta*, on manner above } *M. agathina*, *A. neobule*, *A. esebria* ♂, *A. johnstoni*.
3. *A. lobengula*.

B.

1. *C. candiope* on manner above
2. *P. hippocoon*, } *P. elgiva*.
3. *A. schœneia*, & *P. lycæus*.
4. *P. echerioides* ♂, *E. hiarbas*, *B. goetzius*, *A. phalantha*, *M. agathina*, *T. brigitta*, *A. esebria* ♂, *A. johnstoni*, *A. neobule*, *A. lobengula*.

The details of the mimicry experiment are interesting: the bird probably at first took *P. echerioides* ♂ with upper surface shown for *C. brutus* and, discovering his mistake, took *C. brutus*, till shown its under surface, for the *Papilio*; and in finally refusing the latter probably recognised it for what it was.

2nd experiment : —

Grasshoppers, *N. agatha*, *N. swynnertoni*.	1. *C. candiope*. 2. *A. schœneia*, *P. lycæus*, 3. *E. hiarbas* (not tested against spp. after "also"). 4. *B. severina*, *T. brigitta*, *P. isokani* ♂, *M. rueppelli*, *P. aganice* ♂, *A. caldarena*, *A. igola* ♂ & white ♀, *A. esebria*, *A. johnstoni*, *A. albimaculata*; also *A. phalantha*, *P. hippocoon* with open wings (perhaps taken for *A. dominicanus*), *B. goetzius*, *P. natalensis* ⊕ f. (perhaps taken for an *Acræa*), *Teracolus*, *L. bibulus*.	*P. dardanus* ♂ & *P. hippocoon* ♀, *P. demodocus* ♂, *P. echerioides*, *P. angolanus*.	*C. florella* white & yellow ♀ ♀, *P. piccanini*, *P. zeno*.

The greater readiness to try *P. hippocoon* with closed wings than with open was interesting, occurring as it did in both experiments, in view of the strong upper-surface likeness to *A. dominicanus* and far less good under-surface likeness. The upper-surface refusal of ♂ *P. echerioides* was probably the result of so recent an experience of it.

In both experiments many insects were refused obstinately without tasting that the bird has not tasted since capture, probably in most cases showing previous knowledge, since the bird readily accepted certain other insects. These were in the first experiment *A. lobengula*, *A. neobule*, *A. esebria* ♂, *A. johnstoni*, *N. agathina*, *P. echerioides* ♂ underside, *B. goetzius*, *P. hippocoon* upper surface (taken probably for *A. dominicanus*); in the second experiment *A. albimaculata*, *P. hippocoon* upper side (probably regarded as *A. dominicanus*), *A. johnstoni*, *A. esebria*, *A. igola* ♂ and white ♀, *A. caldarena*, *P. aganice* ♂, *M. rueppelli*, *P. isokani* ♂, *Teracolus*, *P. dardanus* ♂, *P. angolanus*, *Lachnocnema bibulus*, *B. goetzius*, and *P. natalensis* wet f. (probably taken for a large *Acræa*).

The extent to which the bird's preferences as shown to-day should be discounted owing to his being out of sorts and suffering obvious discomfort on approaching repletion can best be judged by a comparison of them with those of other days.]

Exp. 219.—*March* 21. Very hungry, snatched an *A. lobengula* from the forceps, but at once threw it down in disgust, refusing thereafter to touch either it or *A. galene*, uppersides shown. But he showed the greatest eagerness for a *Charaxes* that I was carrying to the bulbuls.

[An excellent illustration of the value of mimicry.]

Exp. 220.—*March* 23. Not very hungry. Most persistently refused without tasting *P. echerioides* ♀ with wings closed and *P. trophonius* both open and closed; he leant forward as though to take the butterfly in the latter position, but withdrew again; he most persistently refused without tasting *Danaida chrysippus*, each surface in turn, and once more *trophonius* upper surface, *A. encedon*, *Mimacræa marshalli*, *A. albimaculata*, and *A. johnstoni*, all with wings open. I then offered the last with closed wings. It was at first ignored, but on my continuing to hold it to the bird was taken, tasted, and rejected. The bird then most persistently refused without tasting *A. caldarena* and *A. igola*, refused but on my pressing it on him tasted perfunctorily and rejected *Callioratis bellatrix*, refused, then in the same way tasted and rejected *B. mesentina* and, having treated *P. echerioides* ♂ (spread) in the same way, refused to touch a *C. brutus* with outspread wings and looking, therefore, like *P. echerioides* ♂. But on my closing them and showing the underside he seized it with the greatest eagerness, crushed the thorax, and swallowed the butterfly wings and all.

He half an hour later refused persistently with shakes of the head to touch the Indian Danaine, *Parantica aglæa* (its wings on an *echerioides* body), but after at first refusing then seemed inclined to attack two Indian Papilios—*P. chaon* and *P. memnon agenor*. Whether he would actually have done so had I not withdrawn them I do not know. Were there sufficient evidence to indicate that this bird had ever been to India I would prefer to accept his evidence, as a more recent migrant, than that of B with regard to these Papilios.

[*C. brutus* preferred to the other recognized African butterflies and, if the roller knows them (as his refusal of *Parantica* might indicate), *P. chaon* and *P. agenor* to *P. aglœa*. Some of the refusals in African butterflies were probably the result of their resemblance to others, and a comparison of the bird's treatment of *P. trophonius* before and after a visual reminder of *D. chrysippus* may usefully be compared with that of my long-caged roller (C), as showing that a comparatively newly-captured bird may be even more impressed by an imperfect likeness than even a long-captive one—as against my remarks in the Introduction. The probable advantage to *C. brutus* of its excellent upperside likeness to *P. echerioides* was very prettily illustrated.

Butterflies refused without tasting that have not yet been tasted since the bird's capture were: *D. chrysippus* (and its mimics *P. trophonius*, *A. encedon*, and *M. marshalli*), *A. albimaculata* (and its mimic *A. johnstoni*—tried, however, when its *under* surface was displayed); but *A. lobengula* was tasted yesterday, *A. caldarena*, *A. igola*, *Callioratis bellatrix*, and *Parantica aglœa* (Oriental).]

Exp. 221.—*March* 25. Refused to touch a black and red *Acrœa esebria*, an *A. johnstoni*, an *A. igola*, an *A. areca* ♂, a *M. yulei*, or a *Terias brigitta*, first refused, then crushed and rejected *M. campina*, *Neptis agatha*, and *N. goochi*, readily ate after crushing them a *P. hippocoon* and an *A. schœneia*, refused, then tried and rejected, an *E. hiarbas*, accepted, crushed, and ate an *H. perspicua*, absolutely refused to taste a very dark ♂ *M. campina*, accepted, tried, and rejected a far paler ♀ (more like *Henotesia perspicua* in general colour), accepted with disinclination, crushed, and rejected a *P. lyœus*, a *P. dardanus* ♂, and an *A. schœneia*, took more readily, I thought, a *Crenis natalensis* and a *P. elgiva*, crushed and threw them back as though to swallow them, but after further crushing rejected each and readily ate a *C. candiope*.

[*Order*:—

P. hippocoon, *H. perspicua*.
1. *C. candiope*.
2. *Crenis natalensis* and *P. elgiva*.
3. *P. lyœus*, *P. dardanus* ♂, and *A. schœneia*.
4. *E. hiarbas*, *N. agatha*, *N. goochi*, *M. campina*.
These, except *A. schœneia*, purely on manner or on degree of inclination apparently shown.
5. *A. esebria* (red and black ♀), *A. johnstoni*, *A. areca* ♂, *M. yulei*, *T. brigitta*.

The incident of the dark and the pale individuals of *M. campina* would seem to illustrate what might occur to the individuals of any species that approached in coloration a less unpleasant known species.

Butterflies refused without tasting that have not been tasted since the bird's capture were: *A. esebria* (chestnut and black), *A. johnstoni*, *A. igola*, *A. areca* ♂, and *Mylothris yulei*.]

Exp. 222.—*March* 27. Refused in turn, then crushed and rejected *Mylothris yulei*, *T. brigitta*, *B. severina*, and *Myc. campina*, readily accepted and, after crushing each, ate an *Atella phalantha* and a *Ph. isokani* ♂ (which I brought up quickly to minimize risk of refusal for a *Mylothris*); tried and rejected *M. campina*, ate readily *N. agatha*, *E. hiarbas*, and *H. perspicua*.

Later. Refused persistently without tasting *T. brigitta*, ate readily *M. campina*, refused without tasting then tried and rejected *T. brigitta*, ate readily *B. severina*.

Later, hungrier, ate readily *T. brigitta*, *M. yulei*, and *A. esebria* ♂, refused most persistently without tasting *D. chrysippus* and *A. lobengula*, accepted, crushed well, and threw away *A. caldarena*. He then ate several grasshoppers, &c., refused, then tried and rejected *T. brigitta* and *M. campina*; more grasshoppers, then tried and rejected *A. phalantha* and *A. hiarbas*, showed an inclination to swallow *A. schœneia* and *P. tugela*, but ended by throwing each away. Refused without tasting, then tried and rejected *P. lyœus* and *P. dardanus* ♂, tried and rejected *P. tugela*, ate readily *C. brutus* and *C. candiope*.

[*Order* :—

N. agatha,
P. isokani ♂,
H. perspicua.

1. *C. brutus* and perhaps *C. candiope*.
2. *A. schœneia* and *P. tugela*, on manner above
3. *E. hiarbas* & *A. phalantha*, probably *P. lyœus* & *P. dardanus* ♂.
4. *M. campina*, *B. severina*.
5. *T. brigitta*, *A. caldarena*, prob. not *above* *T. brigitta*, *M. yulei*, or *A. esebria* ♂.
6. *D. chrysippus* and *A. lobengula*, for which less inclination was shown than for *A. caldarena* and the other species in grade 5.

D. chrysippus, always hitherto refused without tasting, was so refused again to-day.]

Exp. 223.—*March* 27. Towards evening. Refused, then tried and rejected *M. campina*, accepted readily, crushed and ate without hesitation *H. perspicua*, accepted *Papilio echerioides*, but on crushing it threw it away with very evident dislike. Refused without tasting, then tried and rejected *M. campina*, ate readily *Henotesia perspicua*, tried and rejected *E. hiarbas*, *P. lyœus*, and *Tagiades flesus*, apparently regarded white *C. florella* with suspicion, refused, then took it in the point of his bill, crushed it slightly, and dropped it. He also rejected an *A. schœneia*, but he readily accepted, crushed, and swallowed a *Precis clelia*, accepted and crushed a *P. dardanus* ♂, then flung it away, crushed and rejected an *H. perspicua* and *Tagiades flesus*, refused, then rejected a *C. florella* and an *E. hiarbas*, but very readily ate a *P. tugela*. It took me four or five minutes to hunt up another *A. schœneia*; having got it, I offered *C. florella* and *P. lyœus*. The first he refused, the second, after a refusal, crushed and rejected, but he readily ate the *A. schœneia*, then refused to touch *P. dardanus* ♂, *E. hiarbas*, and again *P. lyœus*.

After a short interval he once again crushed and rejected an *E. hiarbas*, accepted and ate a *P. lyœus*, refused, then crushed and rejected, again with marked dislike, a ♂ *P. echerioides*; also, once more, the *E. hiarbas*; accepted and ate a *P. dardanus* ♂ and refused *E. hiarbas* and the *C. florella*. I then adopted my common trick of bringing the latter up quickly and unexpectedly to his bill. He at once seized it, looked a little doubtful when he saw what it was, but after crushing it well, swallowed it with no sign of dislike. He then tasted and rejected *Neptis swynnertoni*, and with almost a show of eagerness seized on a *Leuceronia argia* ♂

which, in the dull light of the verandah, looked not unlike a ♂ *C. florella*, and was possibly mistaken for it. But he showed distinct disappointment on crushing it and flung it away (had the *Catopsilia* been in the first instance mistaken for a *Leuceronia* ?). He went on at once to crush and reject an *N. agatha* and to refuse to taste a *Myc. campina* and a *Terias brigitta* ; but he readily accepted and ate a *Hen. perspicua*, refused to touch a *Bel. gidica*, but crushed and ate an *Axiocerces amanga* ♂, tasted and rejected a *Lycænesthes lemnos*, but readily ate an *A. phalantha*, an *E. hiarbas*, and the *Neptis swynnertoni*. He had become noticeably hungrier during these last few offerings, a delay having resulted from the fact that the envelopes which held the various live butterflies had got mixed, and was searching the ground for grasshoppers. He had found none, but incidentally had picked up and thrown away a *Myc. campina*.

I now allowed a further interval and offered the *Myc. campina*. He readily ate this, refused, but on my pressing it tried but rejected a *Terias brigitta*, then ate another *Myc. campina* and a *B. severina*.

Later again, now very hungry, he ate a *T. brigitta* and an *M. rueppelli*, refused, then tried, and rejected *Amauris lobengula*, but ate a ♀ *Acræa caldarena*.

Then ate a few grasshoppers, refused without tasting, then tried and rejected *A. caldarena*, *A. johnstoni*, and *Terias brigitta*, but readily ate a *Myc. campina*, again refused the *Terias*, but accepted, crushed, and ate the previously-rejected *L. lemnos*, accepted, crushed, and swallowed, but then brought up again and rejected with disgust *P. echerioides* ♂, refusing it when reoffered, tasted very slightly and refused to take a *Terias brigitta*, refused again persistently the *P. echerioides* and refused for a moment *M. campina*, then, changing his mind, accepted and ate it, also a *Bel. gidica*, though he continued to refuse the other two.

After three smallish grasshoppers he crushed and rejected a dead *Bel. severina*, but accepted and ate a *Myc. campina* ; it was not quite a fair test, however, for the *Belenois*, though not actually dry, was commencing to stiffen, and this may quite well have influenced the result. I had rather expected that it would be refused without tasting, and actually it was, I thought, accepted somewhat less readily than the *Mycalesis*.

[*Probable order of preference* :—

A. phalantha, *H. perspicua*, *A. amanga* ♂, *C. florella*.	1. *P. clelia*, *P. tugela*............................			1.
	2. *Ant. schœneia*		2.	
	3. *P. lycæus*, *P. dardanus* ♂.			Grass-hoppers and probably *M. rueppelli*.
N. agatha, *N. swynnertoni*, *L. argia* ♂, *E. hiarbas*.	4. *M. campina*,	*L. lemnos*.		
	5. *B. severina*, *B. gidica*,			
	6. *T. brigitta*, *A. caldarena* ♀, *A. johnstoni*, probably *P. echerioides* ♂.		*T. flesus*.	6.
	7. *Amauris lobengula*, below *Acræa caldarena* and not above *T. brigitta*, *M. rueppelli*, &c.			

The eating of *E. hiarbas and N. swynnertoni* after the *Atella* was probably due to the stimulating effect of the latter, but the fact that they were eaten then at all would possibly show that their place is not very greatly lower.]

Exp. 224.—*March* 28. Refused even to taste *A. caldarena*, *A. johnstoni*, *T. brigitta*, but readily accepted and ate an *M. campina*, again refused, then barely tasted and rejected the *Terias*, but ate an *Argiolaus lalos* and three grasshoppers. He then refused persistently to touch a *T. senegalensis*, refused, then crushed and rejected an *M. campina*, but crushed and readily enough swallowed a *Byblia goetzius*, accepted a *Neptis goochi* with some disinclination, crushed, and dropped it, crushed and readily ate a *Tagiades flesus* and refused to touch again either the *N. goochi* or a second *B. goetzius*. After one more grasshopper he refused a ♂ *L. argia*, then tried and rejected it, accepted readily, crushed, and ate a ♂ *P. dardanus*, refused, then tried and rejected *L. argia*, and after it a *C. florella*. On my removing their wings he crushed both, rejected the *Leuceronia*, but readily ate the *C. florella*, again rejecting the *Leuceronia*. He then ate a *P. lyæus*.

After an interval he crushed and rejected *N. goochi*, crushed and readily ate an *E. hiarbas*, refused a *Neptis agatha*, but crushed and this time ate the *Leuceronia argia* ♂.

Considerably later (he had had a good feed of grasshoppers in the meantime) he refused persistently to touch a *Mycalesis campina* or a *Eurytela hiarbas*. Finally, with an air of "All right—give it me and be hanged to you!" he snatched the latter from the forceps and swallowed it, but refused to touch another, though offered again with coaxing several times during the next twenty minutes. On the last occasion he refused the *Eurytela hiarbas*, opened his mouth and brought up a large pellet, then (immediately) readily accepted not only the *Eurytela hiarbas* but a *Mycalesis campina*. Refused, then tried and rejected *Belenois mesentina*, ate readily another *Mycalesis*, again refused the *Belenois* but changing his mind ate it and crushed and rejected *Mylothris rueppelli* and *Terias brigitta*.

Twenty minutes after the ejection of the pellet he readily accepted, crushed, and ate not only *Mylothris rueppelli* but *Acræa esebria* and *Acræa caldarena*, tasted and rejected ♀ (white-barred) *Acræa doubledayi* and a second ♂ *Acræa caldarena*, crushed and quickly rejected *Mylabris tristigma*, crushed far more thoroughly, seeming inclined to eat it, a *M. oculata*, then threw it away, tasted and at once hastily flung away an *Epilachna*, refused to accept an *Acræa caldarena* ♂, tasted and rejected a red ♀ of *Acræa igola*, crushed an *Acræa johnstoni* well and half swallowed it but brought it up and rejected it, tasted and rejected an *Acræa esebria* ♂, crushed and readily ate *Mylothris yulei*, refused the *Acræa esebria*, refused, then tasted and rejected a *Nyctemera leuconoë*.

After three grasshoppers he refused, then tasted and rejected in turn *Mylothris yulei*, *Terias brigitta*, and *Terias senegalensis*.

After an interval he refused *Acræa caldarena*, but crushed and ate *Nyctemera leuconoë*, refused persistently *Acræa caldarena*, crushed *Acræa johnstoni* well before throwing it away, crushed and swallowed *Papilio echerioides* ♂, brought it up into his bill again, tasted it further and swallowed it finally, refused *Acræa johnstoni*, snatched at a *Mylothris yulei* through the bars (I reserved it for further use), ate a small grasshopper, and crushed and rejected a *Terias brigitta*.

After a further short interval he accepted and ate the *Terias* and snatched again at the *Mylothris*, breaking off and swallowing the head with a small part of the thorax, crushed and rejected *Acræa natalica* and *Acræa caldarena*, then refused each without tasting, readily ate an *Acræa johnstoni,* refused then tried and rejected *Acræa caldarena*, crushed and ate a red ♀ *A. igola* and three grasshoppers.

He then crushed and rejected *Terias brigitta*, accepted and ate the remains of the *Mylothris yulei*, again rejected the *Terias brigitta*, accepted, crushed, and ate a *Terias senegalensis*, refused two or three times, then crushed and rejected *Terias regularis*.

Later (he had had a smallish feed and some two hours then without food) he crushed and rejected an *Amauris albimaculata*, crushed and swallowed an *Amauris lobengula*, and crushed and rejected an *Amauris albimaculata*, *Amauris lobengula*, *Acræa caldarena*, and *Terias brigitta*. He was now looking much annoyed with upraised frontal feathers and had, I believe, made a mistake. He once more refused the *Terias*, also a *Terias regularis*, then tried and rejected the latter, but readily ate a *Belenois severina* and six or seven grasshoppers.

He then accepted and ate a *Mycalesis campina*, refused a *Belenois severina*, ate another *Mycalesis*, and again refused the *Belenois*.

[" *N. goochi* was evidently not liked better than the *Byblia*; nor to judge both from the bird's manner and from his refusal of the *Byblia* only one butterfly later, very much worse."

Probable order:—

T. flesus, *E. hiarbas*. { 1. *P. dardanus* ♂, *P. lycæus*, *C. florella*.
2. *L. argia* ♂.
B. goetzius. 3. *N. goochi* with or just above
4. *M. campina*.
5. *B. severina* and *mesentina*.
Nyctemera leuconoë. { 6. *M. yulei*. } *T. senegalensis*
7. *P. echerioides* ♂. } hereabouts.
8. *A. johnstoni*. 8. } *T. brigitta* about here.
A. esebria. { 9. Red ♀ *A. igola*, *M. oculata* perhaps here. } *T. regularis* not above *M. yulei* and *T. senegalensis*.
A. doubledayi. { 10. *A. caldarena*, *A. natalica*, *M. tristigma* perhaps hereabouts.
11. *Epilachna* 171 possibly, on manner, below even *M. tristigma*.

N. agatha below *L. argia*, *T. flesus*, and *E. hiarbas*.
A. lalos above *A. johnstoni* and *T. brigitta*.
M. rueppelli probably not below *A. caldarena* or above *B. mesentina*.]

Exp. 225.—*March* 31. Refused, then crushed and rejected *Acræa caldarena* ♂. Ate readily *Acræa johnstoni*.

After a medium-sized grasshopper, refused persistently *Acræa johnstoni*, *Mylothris yulei*, and *Terias brigitta*, but ate readily *Belenois mesentina* and *Mycalesis campina*.

Later refused without tasting, then tried and rejected *Acræa esebria*, *Mylothris yulei*, and *Terias brigitta*. Ate readily *Mycalesis campina*.

[*Order*:—
1. *B. mesentina*, *M. campina*.
2. *A. johnstoni*. } *M. yulei*, *T. brigitta*.
3. *A. caldarena* ♂. } *A. esebria* (latter tried only against *Mycalesis*).]

Exp. 226.—*April* 1. Refused most emphatically and persistently *Terias regularis*, refused, then barely tasted and again refused *Belenois severina* and *Mycalesis campina*, tried *well* and rejected *Pseudacræa lucretia* and *Eurytela hiarbas*, ate readily *A. phalantha*, ate readily *Eurytela dryope* and *Henotesia perspicua*, tried and rejected *Eurytela hiarbas*, ate readily *Eurytela dryope.*

I was here interrupted. A little later the bird accepted and ate a *Eurytela hiarbas*, a *Mycalesis campina*, and a *Belenois mesentina*, but refused most emphatically and persistently *Terias regularis.*

[1. *A. phalantha*, *E. dryope*, and perhaps *H. perspicua.*
2. *P. lucretia* and *E. hiarbas*, more seriously considered than
3. *M. campina* and *B. severina*; these less decidedly refused than
4. *Terias regularis*, which later was shown to be also probably, at any rate, not *better* than *B. mesentina.*]

Exp. 227.—*April* 2. *Experiments with Indian butterflies.*—Only moderately hungry. Refused to touch a *Danaida chrysippus*, rubbed somewhat, like its successor, a *Diestogyna* ♀, a much-rubbed specimen, or a *D. c. alcippus*, accepted, crushed, and rejected an *Acræa johnstoni.*

Half-an-hour later, noticeably hungrier, but I did not ascertain the exact degree; he refused an Indian Danaine, *Tirumala septentrionis*, with its own body (relaxed), refused, then pecked disapprovingly at a *Parantica aglæa* furnished with the body of a lively *Danaida chrysippus* (he often pecks without grasping or strikes with the side of his bill, both in token of disapproval), but I withdrew it for further experiment and cannot be certain that he might not have tried it eventually. Refused to touch *Papilio polyctor ganesa* (upperside shown; metallic blue and green), but after refusing the first showed an inclination to accept *Troides darsius*, *Papilio protenor* (both underside), and, after them, *Papilio ganesa* again. The last two were each attached in turn to the body of a *Papilio lyæus*; refused most emphatically to have anything to do with *Parantica aglæa*, *Tirumala septentrionis*, or their mimic *Nepheronia ceylanica*, but showed some slight interest in *Papilio memnon agenor*, ending, however, by refusing it, and again refused to touch *Tirumala septentrionis* or *Parantica aglæa*, but attacked *Papilio protenor*, which, however, I withdrew.

I then gave the bird a feed of grasshoppers, after which, finding I had forgotten to offer the Indian Danaine, *Terpsichrois mulciber*, I did so. The roller persistently refused to touch it, refused *Mycalesis campina*, crushed and rejected *Pseudacræa lucretia*, refused, then crushed and rejected *Eurytela hiarbas.* Tried and rejected *Eurytela dryope*, ate a *Papilio lyæus*, though without enthusiasm, refused to taste again *Eurytela dryope* or *Eurytela hiarbas*, crushed and rejected *Antanartia schæneia*, refused without tasting a *Henotesia perspicua*, a *Papilio dardanus* ♂, a *Papilio lyæus*, and, persistently, a *Papilio demodocus*, but readily accepted, crushed, and ate a *Melanitis leda* and a *Rhopalocampta forestan*, afterwards crushing very thoroughly and throwing away the *A. schæneia* re-offered; but he readily ate, after crushing it, a *Precis artaxia* ⊙ f., refused again to taste *Papilio demodocus* or *Papilio lyæus*, but ate without apparent dislike a *Tagiades flesus* and a *Rhopalocampta libeon*, afterwards refusing *Papilio demodocus*, *Papilio lyæus*, *Antanartia schæneia*, and *Eurytela hiarbas* and *dryope.*

A little later he again refused *Eurytela hiarbas*, readily ate *A. schœneia*, refused, then crushed and rejected *Papilio demodocus*, refused most persistently *Papilio lyœus*, accepted and ate, but this time with disinclination, an *A. schœneia*, refused to taste *Papilio demodocus*, *Papilio lyœus*, or another *A. schœneia*, but accepted, crushed, and ate a *Precis antilope* ⊙ f.

A few minutes later he again refused *Eurytela hiarbas*, accepted, crushed, and threw away the *Papilio demodocus*, refused *Papilio lyœus* and *Papilio dardanus* ♂, refused, with shakes of the head, but finally tasted hesitatingly and, having done so, crushed and swallowed a *Charaxes zoolina*, regarded with apparent suspicion, and three or four times accepted, crushed, and dropped *Precis natalensis* wet f.

After a further and longer interval he refused positively and persistently to touch *Mycalesis campina*, *Neptis goochi*, *Eurytela hiarbas*, *Papilio demodocus* ♀, *Papilio dardanus* ♂, *Papilio lyœus* ♂, *Hypolimnas misippus* ♂, a *Charaxes brutus*, which I offered repeatedly, rubbed round his bill, let flap in front of him and, in short, did everything I knew to tempt him with, and several of the more palatable grasshoppers. He was looking straight in front of him with the thoughtful and abstracted air of a bird about to bring up a pellet.

And, sure enough, he brought it up, immediately afterwards seizing, crushing, and swallowing a grasshopper. I was interrupted here.

Sixteen minutes later he persistently refused *Acrœa johnstoni*, refused for a moment, then changing his mind, accepted and ate a *Mycalesis campina*, then accepted and crushed very thoroughly, but finally threw away and refused to receive again a *Belenois severina*.

I now gave each of the other birds their noon-day feed of grasshoppers, &c., and the roller was disappointed and angry at getting none. He sulked for a time, refusing to accept from me any butterflies whatsoever, even *Charaxes brutus* or *candiope*, which he probably prefers to any grasshoppers, then took to battering against the bars and trying generally to get out to them. Once he refused obstinately *Mycalesis campina* and *Neptis goochi*, but ate readily *Eurytela hiarbas*, barely tasted and refused the next, refused persistently *Neptis goochi*, ate readily *Herpœnia eriphia*, but then ate a *Mycalesis campina*, too. When I finally gave him the grasshoppers he ate them eagerly, even including several species that ordinarily he would not have looked at beside a *Papilio lyœus*, to say nothing of a *Charaxes*. Later he accepted, crushed well, and half swallowed a *Eurytela hiarbas*, but thinking better of it brought it up again, crushed it again, and rejected it. He refused both upperside and underside, then crushed and rejected *Hypolimnas misippus* ♂ and *Papilio demodocus*, refused, then barely tasted and rejected *Papilio dardanus* ♂ accepted and ate a *Tagiades flesus* and a *Henotesia perspicua*, and again refused *Hypolimnas misippus*, *Eurytela hiarbas*, *Papilio demodocus*, and *Papilio dardanus* ♂. A delay of less than five minutes occurred here while I hunted up one or two butterflies ; he then crushed well and swallowed *Precis natalensis* (wet) and ♂ *Hypolimnas misippus*, but refused to touch the *Papilio demodocus* or the *Papilio dardanus*.

Soon afterwards he refused to touch *Mycalesis campina* or *Neptis agatha*, tasted and at once rejected *Eurytela hiarbas*, refused *Atella phalantha*, accepted *Papilio* *demodocus*, crushed it thoroughly and was disposed to swallow it, but changing his mind ended by rejecting it, crushed and at once rejected *Papilio lyæus*, refused persistently to touch an *Everes cissus* (underside shown) or a *Papilio angolanus*, the latter with many shakes of the head, but accepted, crushed, and ate a *Precis antilope* ⊙, refused, then crushed, and threw away an *A. schœneia*, but readily accepted and ate a *Charaxes brutus*.

There was little doubt in my mind that he had liked *Papilio demodocus* at least as well as *Papilio lyæus*.

The *Pseudacræa lucretia* was now dead and beginning to dry, so was not used in the latter part of the experiment.

[1. The points of interest about the Oriental butterflies were the refusal of the Danaines and the refusal of their mimic, *Nepheronia ceylanica*. It is, of course, quite likely that, even if the bird had not been to India he would, in travelling south through Africa, have come across *Tirumala petiverana*, and so have refused Indian butterflies with much the same colour-pattern; and his indecision over the Indian Papilioninæ lends colour to this explanation, though it is opposed by his obstinate refusal of the very different-looking *Terpsichrois*. His refusal of *alcippus*, uncommon at Chirinda, was also probably based on experiences further north, if not in the fore-wing likeness to typical *D. chrysippus*. The latter butterfly, persistently refused ever since the bird's capture, was again refused, and its protective influence on one of its mimics, *Diestogyna*, illustrated, though he had to remind himself of *A. johnstoni* by again tasting it. Further interesting points were his suspicion of *Acræa*-like *P. natalensis* wet f., the pellet incident and its results—less marked than last time,—and the special eagerness shown for grasshoppers (and especially, doubtless, for a square meal) after only butterflies, mostly of unsuitable species, had been offered for some time.

2. *Order of preference*:—

H. eriphia, Grasshoppers, including 1051 and 45.
1. *P. antilope* ⊙ f., *P. artaxia* ⊙ f., *M. leda*, and perhaps *R. forestan* and *libeon*.
2. *A. schœneia*, *H. perspicua*.
C. brutus, *C. zoolina*.
3. *P. demodocus*, *P. lyæus*, ♂ *H. misippus*, and *P. natalensis* ⊕, also hereabouts, the latter probably higher.
4. *E. hiarbas* .... 4.
E. cissus, *P. angolanus*, *P. dardanus* ♂
5. *M. campina* and *B. mesentina*.
6. *A. johnstoni*.
N. agatha, *N. goochi*.
P. lucretia *E. dryope*.
A. phalantha.

Exp. 228.—*April* 3. Readily ate a *Belenois mesentina*, refused to taste a *Terias senegalensis*, but accepted, crushed, and swallowed a *Mylothris rueppelli*, refused, then tasted and rejected a ♂ *Papilio echerioides* and refused a *Terias brigitta* and an *Acræa johnstoni*. After a grasshopper or two he refused a *Belenois*, accepted and ate with disinclination a *Mycalesis campina*, and accepted and ate with distinctly greater readiness a *Papilio angolanus*.

A little later he accepted and ate a *Mycalesis campina* and a large ♀ Saturniid moth with undeveloped wings, which I had found half drowned in a puddle and now gave to "fill up," refused, then tried with disinclination and rejected the next *Mycalesis campina*, but readily ate, after crushing each, an *Eurytela hiarbas*, a *Byblia goetzius*, a *Phrissura isokani* ♂, and a *Papilio angolanus*, a fair-sized grasshopper and another *Byblia*, four or five small grasshoppers, then refused, afterwards rejecting, a *Mycalesis campina*, but crushed and ate a *Neptis agatha*. After a few more small grasshoppers he refused to take either a *Mycalesis campina* or a *Neptis agatha*, but accepted a dry *Papilio angolanus*. It was an old specimen that I took from my collection, having no more fresh ones, in order to ascertain whether the species would now be refused without tasting; it was, of course, rejected. The roller next refused for a moment, then, after looking closely at it, accepted and ate a *Henotesia perspicua*, and accepted a dry *Papilio demodocus*, but on attempting to crush it threw it away, refused to taste an *Everes cissus*, accepted, crushed. and swallowed a *Rhopalocampta libeon*, refused, then accepted, crushed well, and ended by throwing away an *A. schœneia*, showed eagerness for a *Charaxes candiope*, which, however, I reserved, and with equal eagerness accepted and ate a *Cyligramma latona*.

[*Order*:—
Prob. *P. angolanus*, *H. perspicua* and *P. demodocus*.
1. *C. candiope*, *C. latona*, with greater eagerness than
2. *R. libeon*, *A. schœneia*.
P. angolanus, Grasshoppers,
3. *E. hiarbas* and perhaps *B. goetzius* and *P. isokani* ♂.

M. rueppelli above *T. senegalensis*.
3. *N. agatha*........................ 3.
4. *M. campina*.
5. *B. mesentina* at any rate not *below*
6. *T. senegalensis*, *T. brigitta*, *A. johnstoni*, & *P. echerioides* ♂.
Everes cissus.]

Conclusions from Experiments on Captive Rollers.

Many interesting conclusions and suggestions appear to arise from the above experiments. I will postpone the discussion of most of them until I come to publish my far more numerous and equally interesting experiments on very many other species of captive insectivorous birds. I will refer briefly to only one result here. It is that of the fine grading. It would appear that relatively few species of prey are eaten by a given individual enemy to repletion-point. Relatively to enemies *generally*—even individuals of the same species with their slightly-differing tastes—the number of absolute "Grade 1" species is yet further reduced. There are thus probably comparatively few species that do not at some time require to be distinguished by certain enemies from species acceptable nearer to repletion-point than themselves. Where their own parent-form was higher-grade than themselves they will, in order to gain any real advantage from their added nauseousness, have had to be distinguished from that parent-form. Where the present nauseousness has arisen by many steps the oft-repeated necessity for differentiation from successive parent-forms might, theoretically, have in some cases cumulatively brought about, or contributed to, a very high degree of distinctiveness. This view was suggested to me in July, 1911, by my actual experimental results up to that date—in other words, by a consideration of the two lists which I append, and others like them. That on roller B is reinforced, so far as some of the lower grades go, by the unanimous verdict of animals on which I tested Acræinæ more thoroughly than on that roller. I give the tests as I originally worked them out, taking them from my letter of Feb. 16th, 1912, to Mr. Marshall, which he has kindly lent to me. I have worked out the results of each experiment far more exhaustively since and with a better knowledge of at any rate one complicating factor. The work of bringing these results together into one list like the one appended is not quite complete at the moment of my leaving England. I will add it later if I am not in time to replace the present list by it. It will, I believe, entail a few slight alterations in the first four grades. Otherwise (and in the main in those grades) the present list is approximately correct.

Preferences of *Coracias garrulus*. B.

↑ = not lower, possibly higher.
↓ = ,, higher, ,, lower.

1. *Charaxes* spp. (quite 12 spp. tried, including *neanthes* and *ethalion*).
2. *Precis* spp. 10, *Crenis* spp. 2, *C. cloanthe*, *R. libeon*, *P. cardui*, *H. dædalus*, *M. leda*, *Lachnoptera ayresi* (?), *Pyr.* pupa.
   Euralia (*mima* and *wahlbergi*) and *Atella*, first impression; *E. neophron*, *A. galene*, *Salamis* spp. 3, *C. pillaana*, *Arrugia basuta*.
3. *C. florella*, *P. hippocoon*, *antheus*, and *policenes*, poss. *ophidicephalus* (? ↓).
4. *H. hippomene*, *H. perspicua*, *Hesperia* spp. (? ↕), *R. forestan* and *pisistratus*.
   G. hottentota (? ↑) and *T. flesus* hereabouts.
5. *P. lyæus* and, if anything, *slightly* less liked, *P. demodocus*.
6. *P. dardanus* ♂ and *Euxanthe wakefieldi*.
7. *L. argia*. *Herpænia eriphia* apparently hereabouts.
8. *L. thalassina*, *P. angolanus*, prob. *P. leonidas*, and, later placings, *E. wahlbergi* and *misippus*.
9. *E. dryope*, *P. echerioides*.
10. *E. hiarbas*, *P. natalensis* (wet), and *Atella*, latest placings, hereabouts.
11. *N. agatha*, *N. swynnertoni*, *R. forestan* with *Amauris* smell.
    Cyrestis camillus.
12. *N. saclava*, *P. lucretia* and *trimeni*; also, somewhat variably in 11, 12, and 13, *Byblia* spp., *Teracolus* spp., *Phrissina isokani*, and *C. saba* (latter poss. ↑).
13. *N. goochi* and, apparently, *Alæna*, *Teriomima*, *Physcænura*, and *P. peucetia* and *tropicalis*.
14. *M. campina*, *Ypthima* nr. *impura*, *Cycl. metis*. *M. safitza* prob. ↑.
15. *Belenois* spp. 4. *Azanus* spp. (and poss. *T. plinius*) here or even, possibly, lower.

16. *Terias* spp. 3. (*P. angolanus* fell as low as this, but the bird, reassured by a big series, restored it gradually but permanently to 8.)
17. *M. rueppelli.*
18. *M. agathina.*
19. *M. yulei.*
20. *M. leuconoë.* }
21. *A. johnstoni.* } *D. chrysippus* (on strength of mere taste).
22. *A. esebria.*
23. *A. buxtoni*, *A. igola.*
24. *A. asema* and *L. alcesta.*
25. *A. caldarena* and *A. doubledayi* ♂.
26. *A. doubledayi* ♀; prob. *A. natalica.*
27. *A. areca*, *A. lobengula*, and *albimaculata.*
28. *A. dominicanus.* }
29. *D. chrysippus.* } By some birds transposed.
30. Prob. certain beetles, Lepidopterous larvæ, &c., but I have yet to go into this more fully.
31. Prob. *Tetranychus* sp. (?).
32. *Brachycerus* &c. inedible to roller, and certain others through hardness.

PREFERENCES OF *CORACIAS GARRULUS*. C.

(As ascertained by a series of experiments commencing immediately after it was captured.)

1. *Charaxes* spp. } *Cyligramma latona*, *A. neanthes.*
2. *Precis* spp., *M. leda.* }
3. *C. florella.* } *Rhopalocampta* spp., *T. flesus.*
4. *H. hippomene*, *H. perspicua.*
5. *P. lyæus.* }
6. *P. demodocus* and *dardanus* ♂ & ♀. } *P. natalensis* (wet) and *H. misippus.*
7. *E. dryope*, *A. phalantha.* }
8. *Leuceronia* spp., *E. hiarbas.* } *P. angolanus.*
9. *N. agatha* & *swynnertoni*, *P. lucretia* (↑?). }
10. *B. goetzius*, *A. phalantha*, *P. isokani.* } *N. goochi.*
11. *Myc. campina.* *L. bibulus* (?↓ on own merits).
12. *Belenois* spp. and *M. rueppelli.*
13. *M. yulei*, *T. senegalensis*, *L. lemnos*, *Azanus* (?↓), *C. sybaris* and *calice* (?↓).
14. *T. brigitta* (*regularis* not higher than *senegalensis*).
15. *A. johnstoni*, *N. leuconoë*, *P. echerioides* ♂.
16. *A. esebria*, *A. igola.*
17. *A. caldarena*, *A. natalica.*
18. *D. chrysippus* and *A. lobengula.*

NOTE (1912).—I think that the only *essential* difference between B and C's preferences, so far as ascertained, is the transposition of *Terias* and *Mylothris*, *M. rueppelli* being even placed as high as *Belenois* by C. The latter also places

P. echerioides very low, and in this is borne out by other birds; at the same time it is highly suggestive that the drongo, which at first placed not only *P. echerioides* but other *Papilioninæ* in the neighbourhood of *A. caldarena*, should have promoted them, after fuller experience, to about the places they occupy in Roller B's list—*P. echerioides* actually considerably higher. This, in conjunction with that roller's treatment of *P. angolanus* (v. *Terias* in B's list) and the fact that the kingfisher kept the latter butterfly *permanently* in the neighbourhood of *Mylothris*, leads me to suppose that it is not a matter of much difference in preferences, but that the taste of some of these Papilios must be reminiscent of that of some highly distrusted insects—perhaps *Danaida*.

C drew a far harder line than B between Grades 1 and 2. B very frequently placed Grade 2 butterflies, and even those of Grades 3 and 4, in Grade 1.